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FORESTS AND RURAL EMPLOYMENT

At a time when interest in town and country planning in India is beginning to awaken, a small pamphlet* (Circular No. 471 of July 1938), published by the United States Department of Agriculture, is of particular interest. In it the author summarises the salient aspects of forestry in Germany in their relationship to rural employment. It emphasises the fact, borne out by long experience in Germany and other countries, that properly managed forests provide a large and reasonably steady volume of work and thereby contribute in a most valuable manner to the existence and welfare of permanent agriculture and settled rural populations. The introduction points out the contrast in this respect between the treatment accorded to the forest property of Germany and to that of the United States. In the latter, work in the woods, the sawmills and the wood-working industries, has engaged the energies of large numbers of the people ever since North America was settled. Owing, however, to lack of any proper management to insure a sustained yield, it is a sad fact that in most parts of the country forest work has been of a more or less transitory nature. Rapid developments and bustling activity of forest industries were followed sooner or later by equally rapid decline. In districts without good agricultural land, or other natural resources, depletion of the timber was followed by loss of profitable employment. The workers then had to move on to new regions, or were left to eke out a precarious existence. Villages and cities grew up, flourished for a brief period, and finally disappeared.

Very different has been the history of the forests in Germany and other parts of central Europe. There the forests, properly managed on a basis of sustained yield, have constituted a major source of livelihood for permanent communities through many generations. This function of forest in supporting a settled, well-distributed, population has come to be recognized there as a major objective in forest

*"Forests and Employment in Germany," by W. N. Sparhawk, Senior Forest Economist.

policy. It is given at least as much weight as the objective of supplying the national timber requirements and the protection of the soil and water. A special feature of the German national policy is to bring about a better distribution of population by checking the heavy movement from rural areas into the cities and by establishing more people in the less densely populated districts. Another aim is to maintain a stable rural population of small farmers and industrial workers attached, through ownership, to the land. In obtaining these objectives it is obvious that the forest land, comprising more than one-fourth of the land area of Germany, and mostly sub-marginal for agriculture, must do its part. Forests managed so that they are continuously productive afford a large volume of work, which recurs more or less regularly, year after year. Forest work, much of which can be done between late autumn and early spring (November to April), is specially suitable for supplementing farm work and other rural employment. It is, in Germany, the major source of cash income for large numbers of small farmers, particularly in those parts of the country where there are few other opportunities for outside employment. The forests of Germany afford employment at the rate of one person fully employed for every 100 acres of productive forest land. In actual practice several times as many are employed as part-time workers. The manufacture and distribution of forest products employ probably twice as many again, that is to say, one to every 50 acres on a full-time employment basis. Besides the regular work required to exploit the forests and manufacture their products, properly planned management will always have on hand numerous schemes for the development and improvement of the forest property, which perhaps cannot be carried out in normal times when labour is expensive, but which are ready as a reservoir of opportunities for socially useful emergency employment.

The experience of Germany and of other countries in central Europe demonstrates the advantage, from the social standpoint, of having forests and forest industries widely distributed and in reasonable proximity to rural settlements. It is thus possible to have a settled force of permanent workers, living in their own homes and making their livelihoods partly from the forest and partly from their own farms or other occupations. In forestry, as in other industries, large-scale mass production is less desirable, from a social standpoint,

than production in relatively small and scattered units. Production in fairly small units is also better for the forest because it is less likely to involve excessive cutting over large areas.

Nor is there any justification for thinking that exploitation under proper management will curtail production of timber from a forest, over a term of years, in comparison with the wasteful wholesale methods of removal which give no thought beyond the immediate future. Germany has a land area slightly less than that of the three Lake States, Michigan, Wisconsin and Minnesota, in the United States. The annual mean temperatures do not greatly differ, being from 40°—50°F., but the German winters are somewhat warmer and the summers a little cooler. The annual rainfall covers about the same range, from 16 to 35 inches, and both have large areas of sandy plains and moors. The three Lake States have some 47 million acres of arable land and 51 million acres of forest. On the other hand, Germany has about 67 million acres of arable land and only 32 million acres of forest. Yet the annual cut of all classes of timber in the Lake States for four years averaged about 1,250 million cubic feet, while in Germany over the same period the average cut was about 1,750 million cubic feet. Far more significant was the fact that exploitation in the Lake States was estimated to be taking place at a rate twice that at which the forests were putting on increment. Thus capital was being exhausted as well as interest removed. In Germany, on the other hand, the fellings were so regulated that no more than the annual increment was taken.

RESIN TAPPING IN KUMAON

By F. C. Ford Robertson, B.Sc., I.F.S.

Part I.—A Survey of Recent Developments in Field Practice, with Particular Reference to the West Almora Division, U.P.

Abstract.—Details various developments and improvements in setting up and tapping procedure, involving the introduction of tools and gauges of superior design and quality.

This article is by no means everybody's "meat." It can, for instance, hold little interest for those whose forest life is spent outside the Punjab, the United Provinces and Kashmir. They may pass on to their Dipterocarps and sandalwood, or the more catholic interest

aroused by the word *sal,* with an untroubled professional conscience. For their benefit and in extenuation let me just say that resin tapping in this province alone has yielded annual profits of 1 to 2 lakhs of rupees and paid half as much again in wages every year since 1908—so it is no mean forest industry. In the second place, resin is a large, ramifying, even if specialised subject, and although surprisingly little about it has appeared in the pages of this Journal for many years,—and practically nothing concerning the United Provinces—one could not attempt a comprehensive picture within any reasonable compass. Those who wish can refer to such publications as "The Resin Industry in Kumaon"* or, for greater technical detail, to the Punjab leaflet and the United Provinces Resin Instructions—the latter now undergoing a much-needed revision: while the manufacturing side of the business has long since graduated from departmental hands into those of the industrialist and chemical expert, with his vacuum stills and pinenes α and β and the fractious ways of "longifolene."

2. I am taking, in short, the D.F.O.'s view; confining myself to the producer's side of this sticky subject, to certain developments in the actual work in the forest where grimy-garmented, agile hillmen move through the long jungle season to the accompaniment of a steady tap-tapping from country-made adzes.

3. As a minimum frame for my picture, I should just mention that Punjab and United Provinces resin practice follows generally similar lines. Light, continuous tapping, on the French "cup-and-lip" system, has long been the rule in both provinces (in the United Provinces since 1916—20), with a single channel per tree each year and a $4\frac{1}{2}''$ interspace. Of minor differences, I need here only note for my purpose—

United Provinces.	*Punjab.*
Minimum bhg. for tapping $3\frac{1}{2}'$ ...	$4'$;
Prescribed width of channel $3\frac{3}{4}''$ throughout.	$4''$ except in 5th year, when $3''$ only;
Two channels allowed on trees over $7'$ bhg.	Two channels allowed on trees over $6'$ bhg.;

*Bulletin No. 9 (1936).

with a warning that Punjab practice may have changed; our sister provinces care little about keeping each other up to date in developments in their common industry.

4. And now I am going "all U.P." and, alike for brevity's sake and local colour, propose, in what follows, to employ the undernoted resin terms that are in current use throughout Kumaon:

Thokan or "setting up," *i.e.*, preparing the channel and fixing lip, pot and lid;

Kurchan—Adzing the bark to a smooth surface on which the year's channel guide lines and freshening marks can be made;

Pattri—The channel aligning board;

Dhal—the freshened, sloping upper portion of the channel;

Deli—The untouched space between channel base and lip; And also the useful American (not Chinese!) term "face," denoting any one *set* of channels. Our resin terminology, vernacular and otherwise, could do with a lot of titivation and tightening up.

Practical Developments

5. *General.*—Tapping practice, as every "resin" D.F.O. knows, is a matter of *minutiæ*. From channel face to the carrier's hands, it is a business whose successful conduct and control calls for unremitting attention to detail. To an outsider the question of cutting a silly little channel—a shallow gutter some fifteen inches long—an extra quarter of an inch wide, may seem pettifogging to a degree. But the man on the spot, studying his single-channelled stem, can never forget the huge, if invisible, potency of its multiplier—the lakhs of similar stems that, up hill and down dale surround his working hours for many a month of tiring tour. That quarter inch of difference affects not less than 360 *miles* of channel throughout Kumaon; exposes an additional tapping surface likely to yield at least 7,000 extra maunds of resin or the equivalent of over a lakh of extra channels. Again, save a meagre half *tola*—the weight of a single pice—of wasting resin from every tree at each freshening and your annual yield soars by many thousands of maunds. "There's many a slip . . ." is surely

a proverb specially coined for resin tappers or I have studied the base of a channelled *chir* tree to little purpose.

6. The tendency of recent years in Kumaon has definitely been towards a stricter and more intensive control of working. This does not mean that we are multiplying our supervising staff and sitting over the mates and their men with a big stick. It does not mean that the work of these humble folk is being made easier, more fool-proof and fault-free by a careful study and regulation of field practice, notably in the preparations for tapping, as well as by supplying them with tools and gauges of much improved design and quality. And it means, above all, that we are paying far closer attention to the precise locating of channels, an attention forced on us these past few years by a legacy of previous waste and the growing realisation that our tapping areas will last nowhere nearly as long as our predecessors expected.

7. These two main features of our resin work—greater guidance and improved tools for the actual tapper, combined with a stricter control of channelling so as to utilise every legitimate square inch of our remaining tapping space—are discussed in some detail below.

8. *Particular.*—Field operations, in modern practice, fall naturally into three stages—pre-*thokan*, *thokan* and the work of actual tapping.

(*a*) *Pre-thokan work.*—This answers the question "How many channels have we this year and where exactly shall each be cut on the tree." It consists, therefore, of periodic enumerations of tappable trees and the locating of the season's channels by *kurchan* and scribing guide lines.

9. As regards the actual counting of trees, little improvement has been possible. Until very recently all trees in a coupe, being of the same tapping year, were conveniently re-enumerated whenever a new face was started, *i.e.*, every five years. Now, however, the introduction of plumb-line channels—referred to below—has rather complicated our work by leading to coupes having channels of different years, *i.e.*, mixed faces, out of which the first year *thokan* with its enhanced rate of payment (7/- versus 4/- per 1,000) requires to be accurately ascertained. This past season in West Almora we resorted

Fig. 1.—Lateral waste—No consistency of direction: Seventh year of tapping. Second face put haphazard on opposite side of the bole, resulting in waste of interspace. (Note lip left at base of channel.)

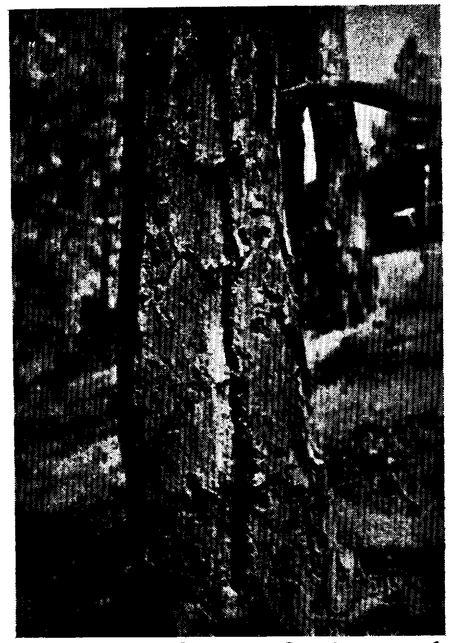

Fig. 2.—Lateral waste—Consistency of direction but not of interspacing: Tree of 5′ 5″ bhg. with 5 faces of 5 years each (25 years' tapping) cut consistently counter-clockwise from channel indicated, but imperfectly spaced, resulting in—4″ (callus 3¾″) + **12″** + 3¾″ (c.3″) + **9½″** + 3¾″ (c.2½″) + **9″** + 4″ (c.2″) + **7″** + 4″ (c.¾″) + **8″**.
(**Bold** type shows interspaces.)

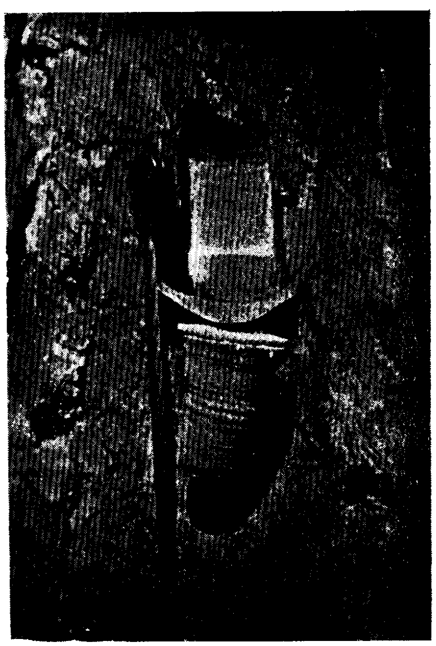

Fig. 3.—Vertical waste: A common fault—1st year **thokan** done too high, wasting 5″ of height. As the ground falls away steeply on this side, a full 5th year channel cannot now be cut. Both adze handle and **pattri** board are now marked off at 6½″ for correct siting of lip.

Fig. 4.—Vertical waste: Lip driven in too near top of channel (only 2½″) resulting in quicker upward cutting next year, and waste of several inches of resin-bearing wood, giving the "bamboo node" effect.

Fig. 5.—Vertical waste: Old (in front) and new (to left) methods of resuming tapping of old faces. Despite bad channel scorching, **thokan** on the left bared fully productive tissue.

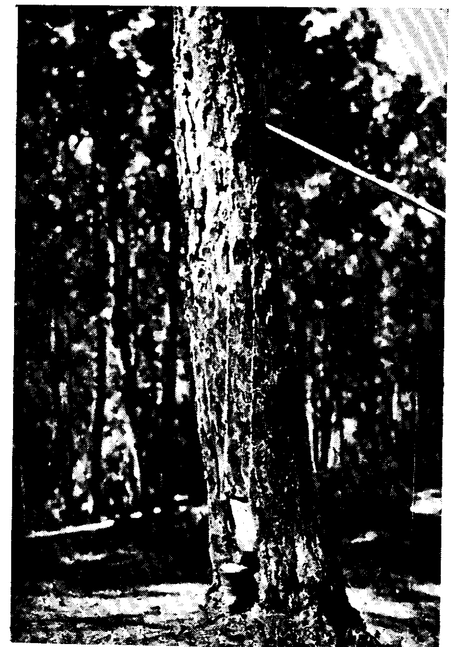

Fig. 6.—Waste from rigidity of system: The result of projecting two faces by plumb line on a leaning bole. The pointer (to right) shows where the new face will meet with the older one.

Fig. 7.—Waste from a conflict of systems: Right hand tree bears 4 vertical channels between two old with-the-grain faces. To squeeze them in, the three lower have been cut edge to edge ("channel stepping") and the fourth, although begun 12″ higher, still operlaps laterally. One reasonably inclined face would have given five years' tapping at nearly half the cost in **thokan.**

Fig. 8.—A typical 1st year thokan: Blaze hardly 4″ high but cut to full breadth ($3\frac{3}{4}$″ to 4″). Note the **kurchan,** minimum 10″ broad which we consider adequate.

to a specially printed enumeration form which provides separate booking of:

The year of face;

The number of new (hitherto untapped) trees } Not previously
Ditto tapped-out (exhausted) trees. } differentiated;

and, as an exceptional measure in 1938—

The number of trees from $3\frac{1}{2}$ feet to 4 feet girth.

10. Although we have no intention of perpetuating complete annual enumerations of the whole area under tapping, an expensive and unnecessary procedure, two successive counts, in which all trees were serially numbered have discovered very many thousands of under-sized trees, this "baby-snatching" being, of course, the mates' favourite method of boosting their 100-channel yield, on which in the past their annual bonus all too much depended.

11. It is in locating and demarcating the channel that most advance has been made. In West Almora, selected Forest Guards and Resin Moharrirs are being specially coached and deputed to work as *munshis,* whose chief responsibility, besides properly supervising and booking the enumerations, is to align channels to the best advantage in all areas where this has become difficult, due, for example, to crooked or channel-crowded boles. They may be required to do this aligning with their own hands or have it done by skilled mates directly under their eye, according as the difficulty of the coupe dictates. And they are given the following guiding rules:

(1) Always continue an old face before starting a new one.

(2) Start new faces clockwise from old and on new trees begin on the south side of the bole (see Figs. 1 and 2).

(3) Except where vertical faces are ordered:

(*a*) on new trees align the face parallel to the axis of the bole and

(*b*) on trees already tapped, align parallel to the existing system *or* to the axis, whichever is more economical of space,

subject in all cases to a *maximum lateral departure from the vertical of one in four.*

12. It will be noted that alignment is governed primarily by the shape or inclination of the bole and has nothing to do with twisted

fibre. This, unfortunately, was not always the case. Channel alignment has run a vexed and varied course in this province. Whatever the rules, past generations of tappers have generally taken the line of least resistance and in coupes carrying any crooked or twisted fibre boles cut every sort of curved or spiral channel—a course which the old round-edged adze abetted. On top of this, a few years ago, came the stern uncompromising order, born (somewhat late) of that wasteful basal pool of resin:

"Lay all channels by plumb line."

13. Now, where trees obliged by growing vertically, with straight, clean boles, this severe geometry had something to commend it. Past channelling on such trees was generally straightforward and the plumb line merely laid a slightly stricter course. But, for better or for worse, most of our areas and certainly all our prize, high yielding coupes, carry a large proportion of more or less leaning or crooked boled trees, associated with a varying, often high degree of twisted fibre. On such mischancy material as this, with its free-hand, tortuous channel systems, the vertical channel vogue has done its very worst. Chiefly, of course, in loss of precious tapping space—I have seen seven years of channel wasted out of ten—but also in the partial girdling effect on the tree, and such subsidiary repercussions as the extra cost of a succession of first year channels (68 per cent. had reverted to first year in one range last season and 53 per cent. in the whole division), the much slower pace of alignment, and the inevitable mixing of faces in one and the same coupe, a state of affairs not previously permitted. An ancient Oriental proverb says that every picture is worth ten thousand words and a not-so-ancient Occidental one that the camera cannot lie: so I shall not labour the matter further but refer the reader to Figs. 6 and 7. Trees in this sort of case are numbered in thousands, especially in our valuable high-yielding areas. And the "channel stepping" seen in Fig. 7, which was a vicious development of the plumb line vogue, is hardly calculated to keep trees in full vigour. The *chir* is a notably long suffering species, but there are limits.

14. The one-in-four rule, now being tried out, gives latitude with little loss, either in tapping space or escaping resin, and the improved plumb line *pattri* (see para. 16 and Fig. 12) allows quick alignment within the prescribed limits. A 7-feet tape, salvaged from

"written offs" and coloured in alternate 4-inch and $4\frac{1}{2}$-inch bands also greatly facilitates the process of fitting in faces on a channel-crowded bole. For the rest, it is safe to say that few trees out of the one-and-a-half million we are now tapping in Kumaon can boast of consistent channelling in one direction round the bole; and probably none with proper spacing as well (*cf.* Figs. 1 and 2). May our new generation of trees fare better!

15. In the actual demarcation of the channels we have also come on a lot. A few years ago the tapper was lucky to have a solitary and vagrant scribe scratch on the rough bole to indicate five years of face, and had himself to adze away the bark from the top of his channel at freshening time. Now everything is done for him. He finds a thorough *kurchan* for not less than 20 inches above the lip and 10 inches broad, on which double guide lines have been scribed to the width and at least the length of his season's channel.* He may also find freshening marks, but that is referred to later (para. 21). These developments can be traced directly to the elaborate tapping control evolved in the big depth-of-channel experiment now completing its 6th year at Garkhet, and voluntarily adopted or adapted by practical D.F.O.'s "Practical?" you demur, "But what of the cost?" Well, we pay Rs. 2-4 per 1,000 channels for the whole work of enumeration, *kurchan* and channel tracking, of which 12 annas comes out of the standard *thokan* rate, so the total annual bill for the division is only some Rs. 1,500 extra, plus a small throw-in for the tools—the extra adzes, *pattris* and scribes. But we look to gain something in tapping efficiency, by relieving the tapper of all preliminaries to the actual freshening, and to an incalculable gain in channel economy by planning every channel ahead so that no bole space is needlessly lost. We are giving the coolie with his adze a beaten path and making it difficult for even the dullest or most feckless of his kind to stray from it. And the thing works—works admirably. We have even improved in some respects on meticulous experimental practice. From this year the ordinary scribe has been abolished. Clumsy and slow in action, its sharply tapering, gouged blade bit variably into the bark, leaving a most uneven track; and if the lines of this were in experienced hands, passably parallel, they seldom kept a constant interval

**Cf.* U.S.A. practice. Even the Naval Stores Handbook contents itself with remarking (p. 45) : "It may some day become the custom to scribe the boundaries of faces on the bark and even to remove the outermost rough bark in advance of the chipping."

from tree to tree. In its place, we have introduced a new type of double scribe, with flat chisel-bladed ends spaced $3\frac{3}{4}$ inches apart and each exactly $\frac{1}{8}$ inch broad, giving a standard track that shows the tapper his exact quarter inch of latitude—from $3\frac{3}{4}$ inches to 4 inches—that we now allow in breadth of channel. This fool-proof labour-saving instrument has been much appreciated, both by those who guide it and those that are guided by it. Its arms or "fork" are made to a thickness defying distortion in use but the actual track it makes is reproduced on the face of the new *pattri* boards for ready check against accident in the field. Figs. 10*a* and 10*b* show the difference between the old and new tracks.

16. The *pattri* itself has likewise been transformed to more exact uses. Hitherto a nondescript board of varied dimensions, it has now graduated into an instrument of some precision. Again, let a picture speak (Fig. 12). We make three lengths:

Minimum or 21 inches—for crooked-boled trees.

Standard or 24 inches.

and

Two-year or 34 inches, for tracking two years of face at one time,

a development in pre-*thokan* economy that has not yet been fully tried out.

(*b*) *Thokan* or actual setting up; *i.e.*, method of starting the channel and catching its flow.

17. Let us begin with the channel itself. As regards 1st year channels there is little change of practice to record except that whereas our rules prescribed an initial blaze 6 inches high by $3\frac{3}{4}$ inches broad, the coolies could rarely be persuaded to cut more than 3—4 inches high (see Fig. 8) and in West Almora Division we have thought it better to recognise this and insist in future on a $3\frac{3}{4}$ inches by 4 inches blaze only. This, it seems, is standard Punjab practice and means a useful saving in channel height, a matter that will be referred to later (see para. 22). The French, by the way, make an even smaller initial blaze. With subsequent year channels, the present *thokan* rules provide simply for raising the old lip to 4 inches from the top of the channel, and no freshening is done until tapping

Fig. 9.—Alternate freshening "ladder": A 2nd year **thokan,** showing adequate **kurchan** (minima 10″ broad by 20″ above lip) and the current year's "ladder" of nine short gradations on left side of the channel guide lines. Note the basal lip.

Fig. 11.—A high yielding or "maldar" tree: In 2nd year of tapping, showing pot and lip left on the basal channel. Extra cost—two pies. The old channel may be scraped but not freshened.

Fig. 10 (a).—Old type of guide lines: Scribe marks of varying and excessive breadth, and barely 4″ broad from outer edge to outer edge. Made with a single-pointed scribe, the track frequently varies in interval from tree to tree and takes time and skill.

Fig. 10 (b).—New type of guide lines: Scribe marks of constant breadth $\frac{1}{8}$″ and interval 4″ from outer edge to outer edge, being made with a double, chisel-pointed scribe in half the time taken by the old single type.

Photos by author: Copyright reserved.

starts. In practice, one almost invariably finds the labour-saving coolie driving in the lip much nearer the top, particularly in channels over-deepened the previous year. Two-and-a-half inches is a common distance. This most distressing and almost universal complaint leads to the "lip lumping" or bamboo node effect so characteristic of channels, old and new, throughout Kumaon. Fig. 4 shows what I mean. A lip stuck into the sloping face or *dhal* protects a portion of the channel face on both sides of it from further cutting—hence the lump when the lip is pulled out. The tapping coolie thinks only of the immediate saving of effort. He does not realise the waste of resin-productive wood nor how unnecessarily he is heightening the channel against himself—may be to the loss of a fifth year's tapping. Even if we are neglecting only 2 inches to 3 inches of tappable surface each season by this practice, the annual loss to Kumaon represents several dozen miles of channel. In West Almora we are not only drumming this into our men, and insisting on lips being driven in at least 5 inches from the top (this 5 inches is marked off on the adze handle) but are also making them freshen the *dhal* itself before fixing the lip. Mates who believe in the value of an early first year *thokan* make little difficulty over this extra work: it looks like paying for itself.

18. Now for a special point in *thokan*. It is a sign of the times, as well as a measure of past economy—or lack of it—that increasing resort has been made of recent years to resuming tapping of old, incomplete faces. The general practice followed to date has been to fix the lip some 6 inches to 8 inches above the top of the old channel and do the usual 1st year *thokan, i.e.*, leaving the usual *deli* between blaze and lip. This past year we have become much more economical. With an old face of about standard depth, and not too ancient or fire damaged, we adze away the top of it until living wood is exposed and continue from that point, *i.e.*, insert the lip there and make a 4 inches *thokan* blaze above it (no *deli*). Otherwise, we put the lip in only 2 inches above the top of the old channel and then do an ordinary 1st year *thokan*. In most cases this exposes completely live and probably extra resin-rich tissue. Fig. 5 shows the old and new methods clearly. As we are now resuming tapping on thousands of uncompleted faces, the saving in tapping space—or

should one say, the gain in tapping life—cannot be lightly disregarded.

19. From channels to lips. As part of their *thokan* work coolies are expected to extract all lips of the previous year, recondition the serviceable ones and use them again on the current year's channels. The annual recovery rate is supposed to be about 90 per cent. Actually, both in West Almora Division and the Ranikhet Cantonment forests I have found the real figures to be far lower—70 to 75 per cent. only—in the past five years, while fragments of embedded lip are a common sight in old faces. Now, even tin-sheet lips cost more than one pie apiece and with Kumaon requiring up to a million-and-a-half every year, big money is involved. Steps to a higher recovery rate with which, of course, the extraction of old lips entire and undamaged is bound up, take the following forms:

(*i*) *Less insistence on deep-driven lips.*—The U.S.A., it is interesting to note, consider deep insertion highly injurious—their channels, of course, are far wider—and hence have resort even to tacking or pegging the lips against the cut surface. With our practice of embedding the lip in both sides or shoulders of the channel, erring on the light side helps to reduce lateral damage to the cambium: moreover, quite lightly embedded lips tighten sufficiently after some weeks.

(*ii*) *Introducing a proper lip-extractor.*—To date, so far as I can discover, Kumaon has been "sending a boy to do a man's work"—has been content to use the *jamura* or ordinary nail-puller, a *kachcha,* narrow clawed pincer, which, however passable for extracting 1½-inch nails, is but ill-adapted for divorcing lips from the year-long sticky embrace of resinous *chir* tissue. Result, an inordinately high percentage of waste by tearing, with its corollary of derelict embedded lips. New types of puller, evolved locally after much experimentation, have strong, cross-hatched, "bull-dog" jaws with six to eight times the gripping frontage, plus an underpiece for leverage; their extra cost, As. 14 *versus* As. 9, we expect to recover many times over in rescued lips during a single season, to say nothing of the fact that they should last thrice as long as their *kachcha* predecessors. They are, to be sure, somewhat heavier but they need be carried round only for a short time. They much resemble, I have discovered, the standard "gutter-puller" (Am. lip-extractor) used in the United States.

And last but not least—

(*iii*) *Paying the men by results.*—With lip recovery merely a routine item in the process of *thokan* (which is paid at fixed rates per 1,000 channels) and using such a poor tool as the old *jamura,* it has always been a difficult matter to assess how much loss was avoidable. With the new tool we are trying out a new system; lopping a little off the *thokan* rate, we are putting lip recovery at a premium by paying 8 annas per 1,000 for reconditioned lips brought to depot and passed by a responsible officer. Where this is being tried we allow no extraction of the previous year's lips till rains break, partly because lips extract more readily then, partly because reconditioning is best done when fire hazard is over, and partly, too, with the idea of minimising fraud. Passed lips will be taken back into stock for re-issuing next season along with new lips, and with the number of channels accurately known our whole control should be tightened up. Areas only recently brought under tapping are excluded from this scheme.

20. Now for pots (and lids). Their manufacture is, for reasons best known to the Kumaoni, still almost entirely in the hands of the Kumhars or plains potters, who come up every cold weather to make the coming season's supply. Nothing, however, will induce these folk to move up until the joys of Dassehra are over and this late start, coupled with a wet winter, may result in an embarrassing shortage of these humble but essential receptacles. To avoid this, the potters' services are now being retained into the hot weather in order to prepare a substantial proportion of next season's supply. This involves somewhat larger and more *pakka*-built—both fenced and roofed—pot sheds, which the assurance of a decent pot reserve amply justifies. We shall also be saved the sort of anxiety occasioned last May by a cataclysmic hailstorm which smashed 60,000 pots in a few minutes and almost beggared us of our earthenware.

21. Lastly, in this section, a word about freshening marks. These are our most recent adaptation from Garkhet experimental technique, where a succession of dots up the side of the channel indicates the thickness of each freshening. Modified to practical divisional needs, we scribe a series of nine graduations ladderwise alongside the channel track with a *kangi* or gauge (see Fig. 12) having two prongs $1\frac{7}{8}$ inches apart, this interval representing a month of

five 3/8-inch freshenings. This *kangi* "ladder," as it is locally called, has come to stay, its eight, monthly intervals providing a useful yard-stick on average tapping progress in any area. Mates, in general, fully understand this but to some of their men it still remains a piece of Sahib's *jadu,* a channel ornamentation that can be scribed on any-old-how. I have found them scribing away, with belated industry, in mid-April, the bottom rung of the "ladder" cheerfully and vaguely retrospective. We are now insisting on the ladder being well and truly made *before freshening starts, i.e.,* during the *thokan,* and starting uncompromisingly at the top of last year's channel on the *opposite* side from last year's ladder. Figure 9 shows how this should be done.

We are stimulating close attention to all these details of *thokan* by giving a greatly increased bonus for tapping, out of which a due proportion of marks is allotted for good *thokan.*

22. It may be noted, in summary, that our drive towards greater channel economy is no less marked up the tree than round it. Vertically, indeed, we look for savings at every step:

(*a*) At 1st year *thokan,* in siting the lip some 6½ inches above ground—indicated by a horizontal scribe stroke during the pre-*thokan* operations, this 6½ inches being marked off on both *pattri* and adze handle (*cf.* Fig. 3)—and by no longer insisting on an initial blaze 6 inches high.

(*b*) Every year, by limiting the season's upward progress to the 15 inches of *kangi* ladder, instead of 18 inches as formerly, while still being vigilant about regular, thin freshenings.

(*c*) By raising the lip at subsequent *thokan,* only to the bottom of the *dhal, i.e.,* 5 to 6 inches from the top of the previous year's channel. This alone saves 2 to 3 inches of channel cutting every year for four years.

23. Upward progress of the face, therefore, now runs:

1st year: pot, lip and *deli* 8 inches, initial *thokan* blaze 4 inches, channel 15 inches; total, say = 27 inches.

2nd year and on: 15 inches each = 60 inches.

Total height of face from ground 87 inches or 7 feet 3 inches, as compared with 105 inches or 8 feet 9 inches officially allowed for in our printed Tapping Instructions. The saving of 1 foot 6 inches

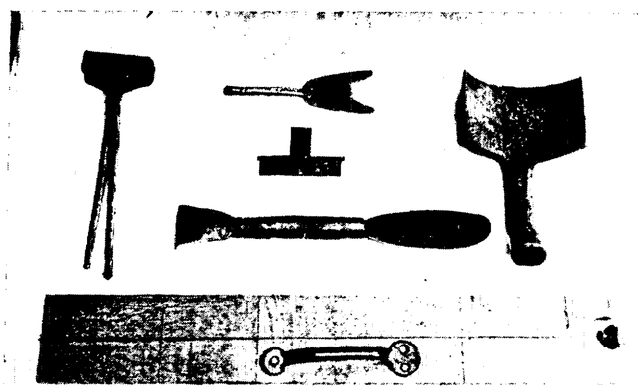

Fig. 12.—Some of the improved types of Resin tools, West Almora Division, United Provinces.

Top left—Lip (and nail) puller **(jamura).** The latest type has a projecting under-piece to give leverage.

Top centre—Freshening gauge **(kangi).**

Top right—Lip chisel with finely tapered blade and 5″ bent handle.

Upper centre—Channel gauge **(paimana)** used by tappers.

Lower centre—Scraper spoon **(daru panaon).**

Bottom—2′ channel board **(pattri).** Note the diagonal lines for 4-in-1 slope, the three transverse lines at 6¼″ (pot height), 15″ and 19″ (length of subsequent and 1st year channels) from bottom of board, and the position of the handle.

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obviates much use of the ladder—a highly unpopular adjunct in these parts—in the 5th year of tapping: formerly, a 5th year used frequently to be abandoned as impracticable, even on quite favourable ground.

(c) *The Actual Tapping.*

24. There is little left to say here, as the coolie finds everything ready for his adze. The guide lines control channel direction and breadth, while the "ladder" sets the average pace of cutting for the season. There remains depth of channel and regularity of freshenings. For light tapping "not deeper than one inch" was long the rule, but of recent years a maximum depth of $\frac{3}{4}$ inch has been strictly enforced. We are now giving our tappers the same official "elbow room" in depth—a quarter of an inch—as we do in breadth. Between $\frac{3}{4}$ inch and 1 inch is allowed, anything shallower or deeper being condemned and punished, and the men keep to this extraordinarily well. We help them by issuing an improved type of channel gauge (*paimana*), accurately cut from sturdy sheet iron in place of the usual flimsy kerosene tin sheeting—see Fig. 12. And, finally, we arm our Forest Guards and *Moharrirs* with a "guard-sheet"—in vernacular—of all the things to look to when a tree is being tapped, graded in descending order of importance, and not forgetting the thick shavings that betray the slack tapper overtaking delayed freshenings. This guard-sheet is educating the executive and through them the tapping coolies to a far higher standard of work.

Standardisation of apparatus.

25. In the foregoing I have had occasion to mention various improvements in tools, notably in *pattris*, scribes, lip pullers and channel gauges. Now resin work utilises over a dozen kinds of apparatus—implements, gauges, etc.—most of which are specialised; and in a region where *lohars* and *mistris* look askance at rulers and reck not of such elementary precision instruments as set-squares and protractors, the desirability of maintaining "type" or standard sets in every resin range seems obvious. We are getting down to this now. As an essential preliminary, every item in use has been carefully scrutinised and tested repeatedly in the field so that all useful refinements can be incorporated. Adze heads, for example, are wanted in two weights, one being a quarter *seer* heavier for cutting basal channels; while the handle has been indelibly marked off at 5 inches,

6½ inches (for siting lips) and 10 inches (minimum breadth of *kurchan*). Similarly, the scribe has now got a 4½ inches length marked along both arms for channel interspace, which seems preferable to the common practice of guessing the interspace from the variable breadth of *pattri* boards. The lip-chisel, too, which in its crude, thick-bladed forms can cause severe cambial damage, has been given a much finer taper and we are experimenting hopefully with bent handles and slanting heads in order to ensure the necessary upward slope on basal lip cuts. We have, further, begun to buy our own high-grade iron and get tools made under departmental supervision by approved artisans. Hitherto our rather haphazard arrangements have revealed more craft than craftmanship among local workmen, who have frequently left the department with substandard, short-service tools, and gauges whose free-hand dimensions bore little relation to their intended use. Again, our new adze-heads are being stamped with the year of manufacture in an effort to discourage substitution: this seems the only resin tool in much danger of finding itself perverted to agricultural uses. Finally, of a piece with this campaign, the cheap spring balances used in so many of our forest dépôts, and forming the basis of our weighment system, are now being replaced by the less portable but much more trustworthy and enduring *tak* or beam balance.

Other recent developments.

26. Chief of these, just introduced in West Almora Division, is the leaving of pots on last year's channels, in general on high-yielding (*maldar*) trees, in particular on basal and 5th year channels. See Fig. 11. Flowing basal channels, of course, are worst for increasing the fire-hazard, while the 5th year channel has no raised lip to catch the resin falling from its *dhal.* It is too early yet to appraise results—and, indeed, a quantitative result would require special measures—but the cost of the experiment is readily ascertained. Every pot, lid, nail and lip so left puts another two pies on the budget, or more than 12/- per 1,000.

27. Another point being tested is whether leaving lips in basal channels will help protect the face from fire, a matter of great moment under existing conditions of not-so-controlled departmental burning (see Part II). After throwing soil on these lips, which the

tappers can easily do at *jar safan*, a considerable measure of immunity is hoped for. This procedure should prove cheaper than packing the face of basal channels with clay, an expedient tried in certain areas of notorious fire-hazard. The lips, of course, can always be recovered at a later stage. Trees in Figs. 1 and 9 show this basal lip.

28. Finally, a homely touch. Last year all mates, forest *moharrirs* and subordinates in resin areas were supplied with haversacks, a much appreciated innovation and an investment that has, I consider, already earned sufficient dividends in efficiency to justify its continuance. These people can now trot round comfortably with a full complement of tools—also spare pottery—and Forest Guards in resin beats are required to carry, in addition to their *kangi*, some nails, lips, lids and at least a couple of pots on their daily round. It is surprising how often this peripatetic stock gets drawn upon: and, in my opinion, it increases not a little a man's interest and sense of responsibility.

(To be continued.)

A DAY IN THE BLACK FOREST

BY C. J. VAN HAEFTEN, P.F.S.

A German lad put the idea of this visit into my head. We were fellow passengers on board a steamer from Harwich to Flushing. He had been hiking in England and was on his way home. I was on my way to Genoa to catch my steamer for India. We got into conversation and in the course of it I mentioned that I was going down the Rhineland. This pleased him. He knew the country well and immediately set to, telling me all the things I should not fail to see. He finished up by strongly advising me to pay a visit to his beloved Black Forest.

At Flushing we parted. He went his way. Mine took me through Amsterdam, Koln, Koblenz, Bingen and Frankfurt. Amidst the beautiful orange and green decorations for Queen Wilhelmina's 40th Jubilee and the odours of Eau-de-Cologne, I forgot all about forests; and it was full ten days before I thought again of my German lad and his Black Forest.

We were then approaching Karlsruhe. We had just passed Mannheim and were running through the beautiful forest country

known as the Odenwald. This brought him back to my mind and immediately I arrived in Karlsruhe I decided to see what I could do about this proposed visit of mine.

A Herr Hug was the person I was told to see. He was out when I called but I was taken instead to his next in command--Herr Leiber, the "Oberforstrat." This gentleman knew no English but with the help of two of his assistants who knew something of it and my smattering of French, I told him who I was, explained to him that I was desirous of seeing the Black Forest and asked him to assist me in doing this. He readily consented and, after consultation with his assistants, decided that one of them—Herr Fritz Lamerdin, a Forstasseur—should take me out for a day.

And so the following morning at 8-30, four days before Hitler made his famous Nuremburg speech--a speech which brought Europe to the brink of war—we left the Haupt Bahnhof of Karlsruhe together to see what he could show me in the short time at our disposal. Less than an hour later we detrained at Baden-Baden, after travelling for the most part through agricultural country with blocks of plantation forest interspersed here and there—a type of country common throughout this part of Germany.

During this journey my companion gave me a description of the Black Forest and explained to me how exactly it was administered. Most of it lies in the Province of Baden, only a small portion of it being in the adjoining Province of Wurtemberg. It is called "Black" because of the colour of its spruce and fir trees and for no other reason. It extends over half the Province but only one-third of it is actually covered by forest. Of the forest land, 17.6 per cent. belongs to the State, 44.3 per cent. is communal property and 38.1 per cent. is private holding.

The head of the Forest Department in Germany is the Reichforstmeister, the post at present being held by Minister Goering. The Head of the Department in the Province of Baden is Herr Hug. He is known as the "Landesforstmeister." He resides at Karlsruhe, the capital of the Province. Under him are ten "Oberforstrats" and they in turn have one hundred "Forstrats" under them. "Oberforstrats" and "Forstrats" correspond in rank to our conservators and district forest officers. Besides these, there are about fifty men who are known as "Forstasseurs" and ten known as "Forstreferenders." All

Forstasseur Fritz Lamerdin.

A Forstwart at Mummel See.

these officers are University-trained men. At the University they are not paid. As forstreferenders they are given stipends. It is only after they become forstasseurs that they draw pay. To correspond with our rangers, foresters and guards they have officers who are called revierforsters, forstwarts and waldhuters.

At Baden-Baden we had to wait till 11-15 a.m. to catch our bus which was to take us further on in our journey into the Black Forest. To while away the time till then, my companion took me around the town, showing me its sights. He took me up first to the castle, known as the "Neueschloss," once the residence of the rulers of the Province but now a public museum and its park a place of recreation. We stayed there for a few minutes, viewing different parts of the forest from its gardens. Then we descended into the Casino, a place which my companion admitted he sometimes visited as he found the play there so refreshing. My experience of such places has been the very opposite. And, lastly, we walked along the town's lovely promenade, but only for a short distance, as it was time by then for us to return. Buses, like trains and everything else in Germany, are perfectly organised and punctuality is their most striking feature.

We left Baden-Baden at 11-15 a.m. and arrived at Mummel See exactly one hour later. It was the furthest we were to travel by bus on our journey that day. It was a delightful trip and cost us each only about two shillings each way. It took us up from almost sea level to an elevation of 1,034 metres. The road for the most part ran through beautiful forest country and as we ascended the change in vegetation was remarkable. From a mixture of species to begin with, we gradually came down to only two predominating ones—spruce and fir. Pines, my friend explained, were generally absent above 400 metres, oaks after 700 metres and birches after 1,100 metres.

Noticeable also was the variation in age-classes. One moment we were overlooking an almost mature crop where thinnings were being carried out. Another and we had before us a triangular or circular patch three or four acres in extent covered by growth ten or fifteen years old. A little later, and we had before us a strip barely a chain wide and about a furlong in length covered with young regeneration a couple of years old. And so it went on till we reached Mummel See, the felled areas getting less and less conspicuous as we ascended.

It was soon evident to me as we went along that forestry here must be a much more serious business than in India. It is true they have not got the factors we have to contend with. Malaria is unknown. They have beetles and bugs but I do not think they are anything like what we have to fight against. They are not troubled with rank, useless species. Yet they seem to give much more attention to their forests than we forest officers in India can ever think of doing. Markings for thinnings, I believe, have to be inspected and approved by superior officers before fellings can be carried out. The selection of areas for final fellings appears to be quite a ticklish business and in deciding on it not only the regeneration on the ground but such matters as elevation, wind, etc., have to be taken into consideration. The growth of each and every tree is carefully watched. I saw no malformed or otherwise useless trees. Every one is treated as a valuable asset to be worth the time and money spent on it.

It was lunch time when we arrived at Mummel See and my friend suggested we call a halt here and refresh ourselves. I, of course, readily fell in with his proposal and we walked into the restaurant to find the place crowded with people in spite of it being a week day. Unlike our forests in India, forests in Europe are great pleasure resorts and people are induced to go out to them and enjoy the pleasures they afford. Excellent roads are provided, restaurants are opened in all convenient localities and very little, if any, restriction is placed on visitors' movements. The only one I heard of was that no fires are allowed within forest limits from February to October—a rather long fire season but apparently one which caused no inconvenience. People in Fascist countries do not grumble unnecessarily. Grumbling seems to be the pastime of democratic people.

Tackling a menu card in Germany is always a big job. I can manage a French one and to some extent an Italian one, but a German one is beyond me. Here was a word taken at random by me from the card:

"SCHLEMMERSCHNITTCHEN"

Is it any wonder I find it so difficult? My friend, however, came to my rescue. Food is good and cheap in Germany and there is always plenty of it. After an excellent lunch in which, appropriately, game figured and which we washed down with a nice cool glass of German

beer, we started again on our journey which was to terminate at Hornisgrinde, the highest peak in the northern portion of the Black Forest, its elevation being 1,166 metres.

We had to do this on foot along a well graded footpath running through forest. Little exploitation was being done at this elevation, it being limited to an odd tree here and there. Regeneration work was confined to restocking gaps made mostly by wind damage. As we walked along, we got talking about forest management and my companion explained to me how this was arranged in the different types of forest. Apparently in private forest there is very little interference by the State in their management, the landlords being allowed to do what they like provided their action in no way endangers the public good. Communal forests are more or less under the management of State forest officers, but all the profits derived from them go to the concerned commune. I do not quite know how these forests fare in Germany but I understand that in some parts of Switzerland and Italy their profits are so great that the concerned communes or local bodies can carry on their administration without much further taxation. What a pity we have no such system in India. It is true that only now are people becoming forest-minded enough to appreciate the benefits forests bring with them, but I do think that one or two of our well managed municipalities or district boards should be encouraged to acquire forest land in their jurisdictions and work them on the lines done in Europe. I am sure, if they can really get down to this business properly, they will never regret the investment. State forests are run much on the lines of our Indian forests but under very much more intensive supervision. Their object of management being mainly to meet the needs of the State, they do not waste time and energy in attempting to grow fancy timber or extraordinary sizes. And yet they make much more use of timber than we do. All the time I was in Germany, I do not remember having come across a single metal telegraph or telephone post. Metal sleepers, too, are rarely seen. Except at stations and a few other places, most of the sleepers I looked at were wooden. Why cannot India give its Forest Department a fair chance and make more use of homegrown timber instead of importing expensive metal substitutes, which, though they may last a little longer, have many disadvantages.

At Hornisgrinde, as at Mummel See, the place was crowded with visitors. Here also there was another restaurant at which a military band was in attendance. Two towers, erected to commemorate events of which I forgot to make a note, afforded those not averse to climbing thirty or forty feet an excellent view of the surrounding country. There were large numbers of girls, some of them in national costume, amongst the visitors, and my young, handsome companion of twenty-seven in his brand-new uniform, donned for the first time that day, soon became an object of interest amongst them. He, however, oblivious of their enticing glances, seemed more concerned about the bareness of Hornisgrinde peak; and lest I should leave the place under the impression that his department was responsible for it, made me listen to a lengthy explanation of the circumstances which caused it.

And so we reached our journey's end. The shadows were lengthening by then and it was already time for us to begin our journey homewards. We walked back to Mummel See by a route different to the one we came up by. Here, as there was still time for our bus, we settled down to a cup of coffee. We must have dallied longer than we intended over this coffee, for when we walked out to look for our bus, we found it had already gone. Our watches showed that we were just two minutes too late—one of the disadvantages of punctuality!

There was nothing else to do but wait for the next bus which was due half an hour later. It turned up to schedule and in an hour deposited us at the railway station of Baden-Baden just in time to catch a train leaving for Karlsruhe. Though the evenings were still long, it was dark by the time we got to Karlsruhe. My companion dined with my wife and myself at our hotel and stayed a while, chatting. Not as long as we would have wished him to, however. He had work to do on the morrow, he said, attending to timber sales. And so, when the time came for him to wish us "auf wiedersehen," I thanked him for his kindness to me and assured him that I would certainly come back (D.V.) as soon as I had the leave and money available. I shall then need no hiking lad to persuade me. It is a grand country and its people are one of the nicest I have come across,

SAL SLEEPERS

It might interest some of your readers, especially those who are Forest Officers in charge of sal forests belonging to States or to Government, to view the sal sleeper trade from the angle of the Forest Lessee who does his own selling and extraction.

In the sal sleeper trade the selling of the sleepers is almost invariably done before the trees are even felled, in fact in many cases before the seller has secured a forest and this leads to many difficulties. It is not the fault of the Railway Board or of any individual Railway or Sleeper Group that this is the state of affairs, nor is it the fault of the Forest Owner. The Railways naturally want to be assured of a supply of sal sleepers well ahead and they, therefore, for the most part, buy through one or other of the Sleeper Groups. The Group collects the requirements of the Railways for, say, a year ahead and issues public tenders. It sometimes happens (though the Group Controllers try to prevent it) that the tenders are issued before the normal time that forest coupes are offered for sale or lease by the Forest Department and thus a supplier who may only have a very small coupe will often gamble on securing a lease of a larger one and will quote and may secure an order that he is unable to fulfil. Such cases, however, are somewhat abnormal, so let us see what happens in the case of a supplier who has a forest, say, on lease, and who tenders and receives an order. Usually the tenders specify delivery over a year's time, and in bulk the quantities of sleepers are, as a rule, fairly compatible with what a normal forest can supply. For instance, tenders may be called for 3,00,000 B.G., 4,00,000 M.G. and 1,00,000 N.G., and if the supplier could get an order in these proportions he would not be in much difficulty over the supply. At least two conditions, however, prevent him getting such an order. One is that his forest is practically certain to be situated in an area where one size of sleeper is unsaleable except at a very low price. For instance, a supplier in Assam or Bengal will get a good price for M.G. and a small price for B.G., but a supplier, say, in the Central Provinces or Orissa can hardly sell M.G. but gets a good price for B.G. The second reason that can prevent the

supplier getting a representative order at reasonable rates is due to the tender system itself. Under this system a supplier cannot approach the Railway and offer the output of his forest with any hope of having his tender accepted. Owing to the situation of the buying Railway, freights and competition, he is not assured of receiving an order that bears much resemblance to his tender. For this reason he cannot very well make and keep stocks as he may not be able to sell them. For instance, he may tender for, say, 10,000 B.G., 20,000 M.G. and 10,000 N.G., representing roughly his normal forest output and find himself with an order for 3,000 B.G. only. This is quite a usual happening.

Having secured this order, the supplier sets out to make the supply. In practically all forest leases there are conditions to the effect that all marked trees must be felled and all trees fully converted. Now this particular supplier of ours only wants 3,000 B.G. over a year but this does not suit the forest owner or forest officer at all. The latter wants a certain number of marked trees felled and converted into any kind of sleepers that can be got out of the timber, sometimes irrespective of whether these sleepers will pass the Railway specification. Indeed, cases are known where suppliers got into grave trouble with the Forest authorities for cutting, say, two slab sleepers from a log instead of two sappy ones and one containing the heart—all three being utterly useless for the Railway.

We thus have arrived at the old problem of the irresistible force and the immovable object. Bringing it down to its simplest terms the supplier may have an order for one B.G. sleeper and the forest owner gives him a tree from which to make it, the said tree being capable of producing, let us say, one N.G. This cripples the supplier who fails in his contract. If the tree is capable of producing, say, two good sleepers 12 feet × 10 inches × 6 inches and the supplier makes the one piece 9 feet × 10 inches × 5 inches that he wants the forest officer sees red.

This is the state of affairs that obtains to-day in many forests and the supplier finds himself trying to accomplish two completely opposing tasks; firstly, the completion of his order, and, secondly, the utilization of the timber he is given, to its (so-called) best advantage, and whichever one he succeeds in doing means almost certain failure in the other.

To remedy this, it would be advisable for the forest owners and officers to adopt a different outlook. It is quite impossible to expect the Railways to place orders for sal sleepers merely to fit into the easiest production that can be got from each forest, and it is, therefore, up to forest owners to help suppliers by marking for them trees that will produce the sleepers required and waiting till the supplier gets another order for smaller sleepers before marking the bad and more or less useless trees.

Of course, we all know what red tape is and the above suggestion will no doubt cause forest officers, especially Government ones, to point out that under the Forest Rules of the Government they could not change their system and that their duty is to conserve the forests and see that they are not wastefully exploited. But are these rules so rigid? Must working plans or felling enumerations or tree-marking completely ignore Railway requirements which, after all, are the mainstay of sal forests? They do at present and tree felling in series or sequence according to the marking has become a fetish that has led to many failures in completing contracts and ultimate loss of forest revenue. The result is that the Railways are more and more inclined to take cast iron or steel sleepers. The raw material for these has not to be dug in parallel straight lines or in pits all neatly numbered and the Railways can rely on delivery of these sleepers. Somebody will probably point to the various Forest Departments who are working sal forests themselves and making a success of supply. But these departments do not tender; a nicely balanced and proportionate order is given them in accordance with their own requirements and, in any case, if they fail they are not penalised like the ordinary supplier. Let them tender as other suppliers do and receive an unsuitable order and see how they will succeed.

It must not be imagined that there is any complaint here against any individual forest owner or officer.

The system above described, however, where Railway and Forest interests clash, does seem to be in need of revision, so is it up to the Railway or the Forest Department or both to attempt the work?

"SHOREA"

ECONOMIC EFFECTS OF DISFORESTMENT IN THE BOMBAY KONKAN

BY D. B. SOTHERS, I.F.S.

An analysis of the figures given in the Land Revenue Administration Report of the Bombay Province for 1936-37 has given some interesting results for that part of the Province known as the Konkan. The Konkan comprises the districts running from north to south of Thana, Kolaba, Ratnagiri and Kanara, with the Portuguese territory of Goa lying between Kanara and Ratnagiri. The tract lies between the sea and the edge of the Western Ghats. The country is very hilly; spurs of high elevation leading from the main ghat system alternate with deep-cut valleys, rivers and spurs taking normally an eastwest direction. The climate is never cold, and from March to May in the interior valleys the heat is most oppressive. The rainfall is abundant and is concentrated almost entirely in the months of June—October. On the coast the rainfall varies from about 70 inches in the north to 120 inches in the south: on the hills inland from the sea this amount is considerably exceeded.

Taking the forest settlement of each district as a unit it may be said that the situation in Thana is reasonably good. The settlement has not been perfect, but on the whole the Forest Department has not much to complain about. In Kolaba the situation is from fair to good in the northern end of the district, but in the south the reservation is patchy and very inadequate, and if, mainly in this area, a further quarter of a million acres had been included in forest the reservation would not have been excessive. In Kanara a very full reservation of forest has been made, but it must be noted that on the coastal belt much of this forest is termed minor forest and is opened to many privileges. Many thousands of acres are already bare laterite rock, and the pressure of an active population, ably supported by a privilege code under which the minor forest is required to supply free grass and grazing, free dead leaf and green

leaf manure, free firewood, free fencing and free material for agricultural instruments and for hutting, is visibly driving the edge of the forest proper back towards the hills and leaving behind an area, which, though forest in name, is practically unproductive.

In Ratnagiri, however, very much worse things have happened, and these can best be explained by an extract taken *verbatim* from the *Gazetteer* published in 1880:

"In 1756, when Fort Victoria was captured by the British most of the tributary ravines and water-courses of the lower reaches of the Bankot creek were clothed with fine teak. Curved teak logs known and highly prized as 'Bankot knees' were largely exported to Bombay, and it is probable that the ribs and framework of most of the fine old ships of the Indian Navy came from Bankot and its neighbourhood. Gradually all forest on the borders of the Savitri and Vashishti rivers was felled, used in ship-building on the creeks, or removed to the Bombay yards. At the same time, Arab traders were carrying to Zanzibar the best timber along the Ratnagiri and Muchkundi rivers. The Marathas had large ship-building yards at Malvan and Vijaydurg. But while they consumed much fine timber, the rulers thought for the future and took steps to preserve the supply. The only valuable teak reserve now left in the south Konkan, 'Bandh tivra' in the Dapoli sub-division, and the Mhan, Dhamapur and Pendur forests at Malvan were sown by Kanhoji Angria about 1680, and in all their territories his successors stringently enforced forest conservancy. Half-way between Bankot and Rajapur, too far from Rajapur and with trade insufficient to attract the Arab ships, the lands along the south banks of the Shastri river and its tributary the Bav were covered with fine forest, mostly teak, much of it of a large size. About the beginning of the present century the district was richly wooded. This was mostly brushwood, but on the slopes and spurs of the Sahyadris, on the undulating red soil strip that runs midway between the Sahyadri range and the sea, and on the banks of many streams, rivers, and estuaries, there was abundance of *ain*, *kinjal*, and teak of no great size but hard and lasting, much valued

for ship-building. At this time the district was thinly peopled, and except round the hill forts, cultivation was scarcely possible. The Peshwa Bajirav, and, after the transfer of the district (1818), the British Government imported and settled labourers; tillage gradually spread, fire and the axe cleared large tracts of dense scrub and even of fine timber, and areas nearly as large again were gradually laid bare to supply wood ashes to enrich the new fields. The Maratha Government always cared for its trees and forests. Though allowed to supply their own wants, the people seem to have been prevented from selling or exporting timber. For some time the British Government maintained the old restrictions; but about 1829, on the suggestion of the Collector, Mr. Dunlop, the forests were, for the most part, placed at the disposal of the people. The land-holders, it was thought, would regard the forests as among their best resources, use them thriftly, and husband them with care. But with almost all the grant was considered a charter for unlicensed, unlimited, and unguarded wood-cutting. The nearness, and the ease and cheapness of the sea carriage to Bombay tempted the people to busy themselves in felling, cutting, and carrying timber. Untold quantities of Ratnagiri wood were, year after year, sent to Bombay. The forests on the south banks of the Shastri and Bav rivers had, until Mr. Dunlop's proclamation, stood almost uninjured. After the proclamation, the land-holders sold the standing timber as fast as they could find buyers, and fleets were built of the largest native craft. The result is that for the present the Ratnagiri forests are almost destroyed."

From the forest point of view Ratnagiri deserves a careful and thorough investigation.

Unfortunately, no time was available for this, but from what could be seen of the northern end of the district in one short day's tour it can at any rate be said that the position has not improved during the last 50 years.

The effect that this disforestment has had on the economic life of the district is shown by the figures given in the following table;

MONEY FIGURES	*Rupees in lacs*			
	Thana	*Kolaba*	*Ratnagiri*	*Kanara*
Land revenue from occupied cultivated land.	15·53	16·65	9·67	9·61
Forest revenue gross	12·97	1·55	·02	15·60
Ditto surplus	8·89	·23	0·00	7·41
Return per acre per annum, land revenue +forest surplus divided by gross area (single rupees)	1·11	1·22	·37	·67
Rough estimate of wages paid to local labour for forest exploitation ..	30·00	4·50	·05	25·00
AREA FIGURES	*Acres in thousands*			
Gross area	2,197	1,386	2,564	2,527
Forest area	913	329	12	2,064
Cultivable & occupied	978	802	1,813	329
Cultivable & unoccupied	11	4	1	58
Uncultivable	158	194	704	0·5
Unassessed cultivable	49	17	8	50
POPULATION	*In thousands*			
	842	628	1,302	417

These figures, as they stand, are open to some minor criticisms. Kanara is not strictly comparable with the other districts, for less than one-third of its area lies below the ghat, and it has not been found feasible to separate the figures for the below-ghat talukas from those of the above-ghat area. The revenue demand does not include figures for land on free tenure. These are .79 lacs for Thana, 1.06 lacs for Kolaba, .93 lacs for Ratnagiri and .05 lacs for Kanara. Again, some of the occupied land is classified as alienated and held on special terms. Such land forms 10.9 per cent. of the cultivated area in Thana, 9.4 per cent. in Kolaba, 12.2 per cent. in Ratnagiri and less than 1 per cent. in Kanara.

After allowing for these minor differences, the figures in the table are sufficiently striking and may well be left to speak for themselves.

If any comment is made, it should be to draw attention to the figures given for uncultivable land in Ratnagiri—7,04,000 acres—and over one-fourth of the total area of the district. In rugged hill country of the Konkan type there must, of necessity, be a proportion of rocky and precipitous areas which, even if classified as forest, would still be unproductive. But there is no reason why the figures for Ratnagiri should exceed the generous allotment of 1,58,000 acres classified under this head in the Thana district. The balance of over half a million acres which might still have been productive is now practically useless land. Without a proper inspection, it would be incorrect to assert that this land is desert and that its ruin is probably complete, but it is feared that when such an inspection is made, part of the area will, at any rate, qualify for such a description.

TIMBER PRICE LIST, NOVEMBER-DECMBER 1938
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing	*Tetrameles nudiflora*	Assam	Logs	Rs. 30-0-0 per ton in Calcutta.
Benteak	*Lagerstrœmia lanceolata*	Bombay	Squares	Rs. 32-0-0 to 80-0-0 per ton.
,,	,,	Madras	Logs	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal	*Pterocarpus marsupium*	Bombay	Logs	Rs. 48-0-0 to 84-0-0 per ton.
,,	,,	Madras	Logs	Rs. 0-15-7 to 1-3-3 per c.ft.
,,	,,	Bihar	Logs	Rs. 0-12-0 to 1-0-0 per c ft
,,	,,	Orissa	Logs	Rs. 0-8-0 to 1-4-0 per c.ft.
Blue pine	*Pinus excelsa*	N. W. F. P.	12′×10″×5″	Rs. 4-7-0 per piece.
,,	,,	Punjab	12′×10″×5″	Rs. 4-13-0 per piece.
Chir	*Pinus longifolia*	N. W. F. P.	9′×10″×5″	Rs. 1-12-0 per piece.
,,	,,	Punjab	9′×10″×5″	
,,	,,	U. P.	9′×10″×5″	Rs. 3-4-0 per sleeper.
Civit	*Swintonia floribunda*	Bengal	Logs	
Deodar	*Cedrus deodara*	Jhelum	Logs	
,,	,,	Punjab	9′×10″×5″	Rs. 3-15-0 per piece.
Dhupa	*Vateria indica*	Madras	Logs	
Fir	*Abies & Picea* spp.	Punjab	9′×10″×5″	
Gamari	*Gmelina arborea*	Orissa	Logs	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan	*Dipterocarpus* spp.	Andamans	Squares	
,,	,,	Assam	Squares	Rs. 50-0-0 per ton.
,,	,,	Bengal	Logs	Rs. 30-0-0 to 35-0-0 per ton.
Haldu	*Adina cordifolia*	Assam	Squares	Rs. 62-8-0 per c.ft.
,,	,,	Bombay	Squares	Rs. 24-0-0 to 68-0-0 per ton.
,,	,,	C. P.	Squares	Rs. 0-13-0 per c.ft.
,,	,,	Madras	Logs	Rs. 1-3-0 per c.ft.
,,	,,	Bihar	Logs	Rs. 0-8-0 per c.ft.
,,	,,	Orissa	Logs	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea	*Hopea parviflora*	Madras	B. G. Sleepers	Rs. 6-0-0 each.
Indian rosewood	*Dalbergia latifolia*	Bombay	Logs	Rs. 52-0-0 to 100-0-0 per ton.
,,	,,	C. P.	Logs	Rs. 0-14-0 to 1-2-0 per c.ft.
,,	,,	Orissa	Logs	Rs. 0-12-0 to 1-4-0 per c.ft.
,,	,,	Madras	Logs	Rs. 1-9-0 to 2-6-10 per c.ft.
Irul	*Xylia xylocarpa*	Madras	B. G. Sleepers	Rs. 6-0-0 each.
Kindal	*Terminalia paniculata*	Madras	Logs	Rs. 1-4-7 to 1-6-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 72-0-0 per ton
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-9-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-14-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 1-10-5 to 4-10-6 per piece.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 31-4-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-3 to 5-4-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-8-0 to 1-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 33-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-11-10 to 1-7-0 per piece.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 0-14-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-4-3 to 2-1-11 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 2-3-3 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-14-0 to 2-13-6 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 140-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

"IN PASSING"

"Hey," said I suddenly to my Dearer Half, "What d'you make of this?" Listen—

'Sheet-washing-plugs-soil-pores.'

"Eh?" said my D.H., looking up from her knitting.

I repeated the five-word caption in a toneless *staccato.*

The wife frowned. "What on earth are you reading now? A code book or the *Launderer's Gazette?*"

Smugly I waved the chaste cover of my November *Indian Forester* at her.

"Oh, *that!*" (the tone of it would have atrophied our Editor). "Really, you Forest Officers . . ." she paused after an elaborate purl, "Say the sentence once more."

I complied.

"It—it sounds rather like a telegram. Why don't you accent the thing?"

"I want *you* to."

"Oh, don't be tiresome. Who's to know what 'Sheet-washing plugs' are? I bet my dhobi doesn't"—(bitterly) "he only uses boulders. And, anyway, why should they soil one's pores—washing shouldn't do that . . . drat it, man, the thing doesn't make sense."

"Quite."

"—it's not even *English.*"

"I don't suppose it's meant to be," I rejoined cautiously, "I suspect something, er, transpontine. The *I.F.* bristles with vernacular, you know."

"Well, if your great brain boggles at it, you have an obvious remedy."

"Namely?"

"Write to the Editor about it."

Which, in a way, is just what I have done.

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REVIEWS

ANNUAL FOREST ADMINISTRATION REPORT OF THE BOMBAY PRESIDENCY, 1936-37, PART I

The Government's forest area in Bombay remained practically unchanged during the year 1936-37 at 12,998 square miles. The area in charge of the Forest Department is 10,741 square miles of which 7,456 square miles are listed as organised under various silvicultural systems. It is not clear, however, whether this represents the total area under sanctioned working plans. Judging from the fact that protection and grazing are included in the 30 per cent. shown as not under silvicultural systems, probably the percentage of the total which is under working plans is considerably larger than these figures indicate.

Revenue fell by Rs. 4,38,345 to Rs. 47,71,682 in comparison with Rs. 52,10,029 for 1935-36. Expenditure also rose slightly from Rs. 27,85,678 to Rs. 28,07,104, giving a net decrease of Rs. 4,59,771. The surplus of Rs. 19,64,580 still represented 41.2 per cent. of the gross revenue.

Most of the work undertaken in connection with working plans during the year seems to have been concentrated on revision of existing plans. It is satisfactory to note that in several cases opportunity was being taken at the time of revision to amalgamate several separate plans for relatively small areas into one consolidated plan. This is a reform which is certainly much to be desired as the multiplicity of plans which has hitherto existed in several divisions only tended to confusion.

The quantity of produce extracted, both timber and fuel, showed a small decrease from the previous year while sandalwood sales fell by Rs. 25,135, bamboos by Rs. 5,528 and miscellaneous minor produce by Rs. 12,084. Prices realised for timber and logs sold in Government depôts were satisfactory as they ruled only a little lower than the purely speculative prices which had been obtained in the previous year.

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FOREST ADMINISTRATION REPORT OF COORG, 1937-38

Working Plans.—The working plan for the evergreen forests by Mr. Van Haeften was sanctioned and will come into force from 1st April next. It marks an important stage in the development of regulated forest management in Coorg. The working plan for the deciduous forests is now in need of further revision in the light of knowledge gained since the plan was written. The decision to resume an active policy of forming sandal plantations within the reserved forests having necessitated alterations to the prescriptions of the working plan, which was recently prepared by Mr. Mitchell for the sandal tracts, its introduction has been delayed. With the completion of this very important plan, all the more important forests in Coorg will have been brought under regulated management. All deviations from the prescriptions of these plans will, in future, be controlled by the Inspector-General of Forests to whom the control forms will be submitted for check.

Forest Protection.—The total number of forest offences during the year was 28; the corresponding figure in the previous year was 39. The fact that not a single case of theft of sandalwood occurred during the year speaks very highly for the Forest Department's control over its sandalwood operations. Unfavourable climatic conditions are responsible for the less satisfactory fire record, the number of fires in the reserved forests increasing from seven, being 322 acres in the previous year, to 21, being 1,610 acres in the year under review. Similarly, in the unreserves, the area burnt increased from 453 acres to 3,358 acres.

Despite the prolonged drought and consequent combustible state of deciduous forests, the percentage of success was still as high as 98.9.

Control measures to combat the spike disease were continued, the total number of sandal trees uprooted or treated with Sodium arsenite or with Atlas solution being 2,433 as compared with 1,028 trees so treated in the previous year. Fresh outbreaks, involving 20 trees in all, were reported from three localities hitherto immune from spike.

Silviculture.—Chapter III of the report deals with silviculture and while several pages are devoted to an account of artificial regeneration in the deciduous forests and mention is made of the attempts to supplement the natural regeneration of the evergreen forests by artificial regeneration, no information is vouchsafed as to the progress of the natural regeneration of the latter forests. It is not until Chapter VI is reached that one learns that "the natural regeneration in this area (Urti Coupe I) is splendid" and that the "gradual opening created as a result of the slow process of dying of the trees appears to be the most suitable method for the development of natural regeneration of valuable species in these evergreen forests."

This slow process of dying is the result of the frill girdling and poisoning with a solution of Sodium arsenite of unwanted trees interfering with valuable species.

As the justification for the exploitation of these evergreen forests rests on the ability of the management to secure adequate natural regeneration of the valuable species, the importance of these operations merits some mention of their progress in Chapter III of the Report. Owing to the impossibility of obtaining natural regeneration, the deciduous forests are treated under the system of clear felling followed by artificial regeneration of teak, in conjunction with field crops.

The method of dibbling teak seed at stake has been replaced by stump planting, the best date for which is stated to be between 25th April and 15th May. This system will reduce weeding and consequently planting costs. The great importance of pre-monsoon stump planting here lies in the retarding effect of the *ragi*, the field crop which the cultivators insist on growing in the *taungyas*.

Exploitation.—Owing to the difficulties of extraction in the evergreen forests no purchaser would consider buying the standing timber on the usual one-year contract. Hence it has been necessary to grant a longer-term contract and the forests are now being worked out on a three-year contract, the contractor paying the Department royalty on the timber removed.

In the deciduous forests, all felling, logging and extraction is done departmentally and the total volume of timber so handled by

the staff during the year amounted to 1,23,281 cubic feet. Such work leaves the staff little time to attend to its more legitimate duties.

Financial Results.—The year was financially a very successful one—the surplus at Rs. 2,00,870 being Rs. 63,051 higher than that of the previous year and Rs. 17,000 above the average of the past five years. The gross revenue increased from Rs. 3,49,215 to Rs. 4,04,528 —the main reasons being higher prices for and larger quantity of sandalwood marketed, the average sale-price increasing from Rs. 760 to Rs. 850 per ton, and the quantity sold being increased from 105 to 154 tons. Expenditure was, on the other hand, lower. This was due to reduction in the cost of departmental timber operations and to less royalty paid on sandalwood removed from the private unredeemed lands. Expenditure was Rs. 2,03,658 in the year under review as compared with Rs. 2,11,396 in 1936-37, the average expenditure for the five years ending 1935-36 being Rs. 2,03,550.

L. M.

THE EIGHTEENTH ANNUAL REPORT OF THE FORESTRY COMMISSIONERS IN ENGLAND FOR THE YEAR ENDING 30TH SEPTEMBER 1937.

LONDON : H. M. STATIONERY OFFICE. PRICE 7/- NET.

This report gives an interesting account of the work undertaken to give effect to the Government policy for the Special Areas in connexion with afforestation. The scheme proposed envisaged the acquisition of 100,000 acres of plantable land, its afforestation and the formation of 500 forest workers' holdings in three years. This proposal was regarded as an experimental scheme which, if successful, would be followed by a larger one covering 200,000 acres and 1,000 holdings to be established in ten years. By the end of the year under review, 42,900 acres of plantable land had been acquired, divided in about equal proportions between the Northern Area (Durham, Tyneside, Haltwhistle and West Cumberland) and the South Wales Area.

Nursery work had to be considerably extended and a large new nursery was established at Tair Onen in the neighbourhood of Cardiff. At this nursery seventeen forest workers' holdings were established.

The report also records the fact that during the year the total acquisitions for forestry purposes in the British Isles passed the one

million acre mark, the total at the end of the year being 1,008,500 acres.

The Commission is now engaged in making a census of woodlands in Great Britain, the last census having been made in 1924.

E. A. G.

EXTRACTS

WILD LIFE IN INDIA

The **Manchester Guardian,** in its issue of 31st August 1938, published the following under the heading "The Empire's Wild Life."

"Dr. Edward Thompson, who is well acquainted with the Indian scene from many angles, lately gave warning that if steps are not taken to check indiscriminate hunting in India, the country will some day be faced with 'empty jungles.' His fears are supported by an article which Lieutenant-Colonel C. H. Stockley contributes to the current number of the 'Journal of the Society for the Preservation of the Flora of the Empire.' He speaks of areas in which certain species have been 'completely wiped out' among them many that, like the wild goat or the Sind ibex, 'do no harm whatever to crops or stock.' One main cause of this extermination is the number of the unlicensed guns that are used. He mentions a village in the Himalayas where nine guns are licensed for crop protection but where there are forty unlicensed, with the result that 'deer and game birds have been entirely destroyed for miles around.' The small profit that can be made from meat or hides is incentive enough to send poachers travelling on lorries even into the reserves. Some times this wholesale disturbance of the balance of nature has obviously disastrous results. The shooting of bison and deer for the hides in the Eastern Ghats, for instance, has so deprived the tigers of their natural food that 'the number of man-eaters and cattle-killers has increased to an alarming extent.' There is clearly need for education and enactments designed to remind the reckless hunter that, as Mr. H. G. Maurice puts it in another article in the journal, if *nature's mechanism has a link broken, 'She will in the process of* executing running repairs probably hit man on the head with a spanner.' Fortunately the summoning of an international conference on the preservation of wild life in the East may shortly result in the taking of measures of control similar to those that are already beginning to show such good results in Africa."

CONFERENCE OF FOREST OFFICERS OF BIHAR

The following speeches were made at the Conference of Forest Officers of Bihar which was held at Ranchi on 10th September 1938:

MR. OWDEN'S SPEECH

"HON'BLE PRIME MINISTER AND GENTLEMEN,

Before I mention the objects of calling this conference, I wish to express my pleasure and gratitude to the Hon'ble Prime Minister for condescending to spare so much of his valuable time to open this conference. I am quite sure that all officers of this Department feel the same about it. At the risk possibly of offending, however, I wish to take the advantage before I leave the Province to express my views which have been gained by five years of continuous service as Conservator of Forests for this Province. They are that this Department and what it stands for in the development of the country has not as a rule received enough of that measure of consideration which it should have. The tendency to look upon the Department purely as a revenue producer is not good. The old adage that it is unwise to kill the goose that lays the golden egg applies very aptly to the Forest Department. Just as the goose must lay golden eggs so also we must admit and do admit that our department must pay more and more revenue to fill the Government's treasuries. But just as the goose to lay its purest and biggest golden eggs must be fed with the most suitable food of which we have not the full experience and just as even after we have found the most suitable food we cannot expect an immediate return of golden eggs till the goose itself develops sufficiently, so also the Forest Department has to find out by research and experiment what are the best foods or treatments and methods of obtaining and administering them which will lead to its fuller development.

In forest work, conditions are generally so varied that no one food or treatment is applicable in all cases, hence the great importance of a conference of this sort, where the experiences of all can be pooled and pulled to pieces to find out from them what is good and of general application and what only of particular applicability and why. Such conferences give a means of analysing many experiences which Forest Officers imbibe in their day-to-day work in practical forestry. They serve also the very useful purpose of exercising requisite check on ambitious theory. They give a more dependable line

of action to be followed in administering the foods and treatments which research shows to be advisable and possible theoretically.

If we decide on a definite course of food and treatment, the necessary funds for producing the desired effect must naturally be forthcoming if the goose or the Forest Department is to be properly developed. As with the goose, the Forest Department does not flourish on a glut one year and starvation the next, the goose as it grows needs more and more to consume to develop to its full; but it needs that in rhythmic quantities, proportionate to its own development. So also for the proper development of this Department a fixed, not too ambitious, progression of development is required as its best food. As it lays better and better eggs it is wise to feed it more and more. Give it the food and treatment which induce good laying and in hard times it will be better able to live on its own resources.

Some of these foods and treatment are:

(1) Good roads and communications to transport its yield at lowest cost so that greater profit will come to the Department and not loss to the poor carter by dead bullocks or to the purchaser by money paid for produce purchased which, because of lack of means of transport, he has had to leave in the forest to rot. Develop methods of exploitation and cheaper extraction by using the force of nature rather than by forcing nature to do what it was never intended to do. The bullock or buffalo was never intended by nature to drag timber over impassable roads whereas timber automatically floats downstream and incidentally improves in the floating. Such improvements in extraction will enable fuller utilization of produce and so less difficulty and cost in regenerating our felled areas and later, in looking after their further development for even cleanings can then be useful. Incidentally also they render the lot of the Forest Officers, contractors, labour and everyone else easier and by their ameliorating effect result in all round better work, better returns and eventually reduced expenditure to the Department itself. With these improvements can be included the functioning of gas producer plants and so further demand for charcoal from what is at present waste produce.

(2) Good quarters to the Staff of all grades which ensure intimate and careful check of work and more work. A happier, healthier and more contented Staff means greater control and so better application of funds available to essential need of young crops rather than waste on unessentials which originate from lack of control resulting from insufficient accommodation fostering discontent and ill health.

(3) Adequate funds to look after and care for the forests, which are the pride of every Forest Officer, by protection from that fiend, fire; care of the young stock at the right time without fear that funds will not be available if a Divisional Forest Officer sees that treatment is needed, creepers have to be cut, thinnings and cleanings are essential for the better development of the stock on the ground. And Nature is so thankful for such aids that it returns the fruits of such attention a hundred-fold, not only by improvement of the crop itself but by its action on climate on much of the surrounding poor area.

(4) Money spent on forest work goes straight to the pockets of labour, the villagers who live in and around the forest. If plenty and regular work be available your villager's attitude towards his forests will change. He grows to regard them, as he should, as his spring of added blessing, his friend in need to which he can always turn for a means of healthy life.

(5) As the Hon'ble Minister knows well, any money spent in the forest is spent in the country and remains in the country to better it: for Nature never returns evil for good. Yet, although she strives not to return evil for evil, man by his selfishness often makes her aim impossible.

There is much more that I could say on this subject but I do not wish to detain you too long, Sir. You are our Minister and I feel that you have the interests of the Department at heart, for it is a part and parcel of your Province on which you can and must depend. Realize its importance as we depict it and give us the support and backing we need, Sir, to make ourselves a proud and profitable department of your Government. Give us the food—the

funds—we need for full development as we indicate them to be necessary and as our development indicates to be desirable and possible and I can assure you that not one rupee of what you spend will be wasted or fail to return its reward—not only directly but through many indirect channels. As with the goose, direct money returns are not always possible immediately but as we develop with greater and greater care the funds bestowed upon us so will our revenue position improve.

This will be considerably enhanced by a strong policy of acquisition of forests at present not under our control and subject to irregular working. Bihar has 1.7 per cent. of its total area under controlled forest management where it should have 15 per cent. If we act quickly we may be able to save 10 per cent. and there is no time to lose.

I have had it hinted to me before now that our claim to greater expenditure on our forests as other provinces have done is not tenable because we do not know the capital value of our forests. I do not know if this is a serious contention of Government but I think that, looking at the Forest Department as a purely commercial concern, if we spend five lakhs of rupees in a year and get a return of one lakh, *i.e.,* 20 per cent. on money spent in 12 months, the return on the investment is nothing but handsome. In fact, it might well be termed profiteering, especially if none is put back into the forest. God has given us a forest property such as it is and not told us what He paid for it. Is that any reason why we should not better it to our own advantage by investment of a little more. I submit, Sir, that we are failing in our stewardship if we fail to develop it to its best by whole-hearted support which includes the spending of a portion of the profits in its further improvement. In 1937-38 we have paid a surplus of Rs. 1,31,783 and it might have been 1½ lakhs on an expenditure of Rs. 5,69,143, *i.e.,* more than 23 per cent. on the investment. Is there any real reason, Sir, why at least 5 per cent. extra or anything over 15 per cent. profit on working should not go back into the forest as investment in your property in one of the mainstays of your country which can grow to great importance?

I am going on leave, Sir, and I am being succeeded by Mr. Sabharwal, an officer of considerable and long experience of Bihar. He may really be referred to as the father of our present policy of afforestation and saving of the remnants. He is still

interested and he will strive, and I know strive hard, to put the picture of the future as we of the Forest Department see it needs to be painted. He will need support, Sir, and I trust that your own and his firm aim will be to raise the available forest area controlled under management of the Forest Department of the Province from its present 1.7 per cent. to at least 10 per cent. for it is needed, as is the rapidest improvement of all forests available also needed. This can only be achieved by hard work and funds but it will have its reward in better conditions, more employment and more revenue. Our main trouble is that so little of our work, requirements and the implication and indirect influence of our existence are properly understood by those who control our destiny. In all my five years here, I have had only one of these controllers, Sir Maurice Hallett himself, inspect my forests to learn what we do and have to do.

This conference has been called, Sir, with a view to discussing some of the means to the end of devising some of the aids and treatments suitable for improvement which I have indicated to be desirable. The results of these discussions will, in due course, be brought specially to your notice and to the notice of Government and I hope that they will meet with the support we desire they should.

With these words, Sir, I now request you to declare the conference open."

PRIME MINISTER'S SPEECH

"MR. OWDEN AND GENTLEMEN,

Yesterday, when our Revenue Secretary phoned to me that you were to meet at a conference to discuss the problems regarding the forests and requested me to attend the conference, I could not refuse his request. You must be knowing that it always gives me extreme pleasure to come in contact with officers of the various departments of Government because if I meet them they can contribute their viewpoints more intimately and I think, after hearing the speech of Mr. Owden, I have been justified in acceding to the request of the Revenue Secretary. These conferences serve a useful purpose in every department of Government and you must know that we are living in a time when there is a great change in the conception of Government. The Government has to deal with all the departments and the life of the people in the country. Every department of the Government has got some individual responsibility of the lives of the people

and it is because of this that I think always that no department of Government is such as not to deserve the fullest sympathy at the hands of those on whom the administration has been placed. It is because of this that these conferences are of very great importance. You, gentlemen, are meeting here to-day to discuss the problems of your department. By sitting round a table and exchanging views, you can come to a decision more easily than can be done through letters and correspondence. There was a time when, according to the layman, the forest was the haunt of wild beasts and men looked upon the forest with an idea of terror. Now we are living in an age of science and people have come to realise that the forest also has got a great purpose. It has got something to do with the climate of the country, it has something to do with the floods of the country and it is a source of employment to the people also. Of Chota Nagpur particularly forest is a vital part. I must confess that I do not know much about these forests but from what little I have learnt I know that we have not good forests. It is very necessary that we should improve these forests. Forests, I think, are truly very valuable as has been explained by Mr. Owden in his speech. I am sure that the Government will extend legitimate assistance to all those schemes which the Department may evolve. Mr. Owden has done a good deal for the improvement of the forests and I am sorry that he is going away. Mr. Sabharwal will be here and I hope he will follow his steps. Any schemes coming to Government will have the best attention of Government for our Government is anxious to support all schemes that can be shown to be for the good of the people. Certainly, gentlemen, you must expect that before Government gives its support to these schemes it should be convinced of their soundness.

I again congratulate you on the idea of the conference. Here I hope you will discuss the matter amongst yourselves and you will come to Government with a certain decision and Government will not be sparing in its efforts to do all it can to improve the forests. With these few words I open the conference."

The Forest Officers then presented a silver salver to Mr. Owden as a token of their esteem for his personality and his valuable services. The Hon'ble Premier, handing over the tray to Mr. Owden, said:

"I am certainly sorry to lose Mr. Owden. He is a man of ideas and within the short period that he has been in the post he has been

making demands for funds for the improvement of the forests. It was a pleasure to read his letters and I always thought that for the improvement of forests the department must have a man of ideas. Mr. Owden is going away from this Province and I hope Mr. Sabharwal will carry out the ideas he has given to this Department in contour trenching schemes and Government is anxiously waiting to learn the results for which I hope you will all try."

"DEMONS THAT THREATEN CIVILIZATION" DEFORESTATION AND SOIL EROSION

NEED OF FUNDS

Presidential Address at the Central Irrigation Board Meeting

> "Deforestation and soil erosion not only intensify floods and reduce the cold weather discharges of our surplus streams but they threaten our subsoil water supply and they impoverish the soil and reduce the output of agriculture. In fact, these two demons threaten the very basis of civilization and of human life itself and it is high time that Governments combined in concerted defence measures."

This remarkable statement occurs in the Presidential address delivered by Mr. M. R. Richardson, C.I.E., at the ninth annual meeting of the Central Board of Irrigation, recently held in Delhi.

"The longer these are delayed," continues Mr. M. R. Richardson, "the more expensive will be the remedies and the more prolonged the period of recovery and of avoidable human poverty and want. A successful defence is of more vital interest to the generations that will follow us, but the initial responsibility is ours. The uninformed layman—and even ministers of Government who are, at any rate, partially informed laymen—is often almost oblivious of the disastrous results which follow from neglect of forests and ignoring of the problems of erosion. When asked to provide funds, he says 'give me your proofs.' Unfortunately, local proofs cannot be given till the damage is so serious and widespread as to be difficult of remedy. History affords many proofs. For example, Mesopotamia, China and America."

"America is now fully alive to the disaster which threatens her and has even formed a special department of engineers to deal with erosion while her forests are actively fighting deforestation.

"There are many indications that in parts of India conditions are, at least, as bad and, sometimes, worse than they are in America. For instance, the Ganges carries to the sea eight times the quantity of silt carried by the Mississippi and that from a catchment area less than one-third the size.

"It is not without significance that the highest recorded flood in the Ganges occurred in 1924 and that the lowest recorded winter discharge occurred in 1929. We have records of the Ganges for over 100 years and this period is long enough to exclude all seasonal cycles."

AMERICAN RESEARCH

"American research has found that during the years 1935 to 1937 the rate of run-off from completely denuded land, such as is only too common on the banks of some of our rivers, such as the Jumna and the Chambal, is twenty times greater than it is from preserved forests. During one month of the flood season in southern California a watershed, which had been burnt out four years previously, was denuded of 120,000 cubic yards of top-soil or a depth of 1.4 inches per square mile. On a similar watershed, burnt out 19 years previously, the denudation rate was only one-tenth of this, while in a watershed fully protected for the last fifty years the same rainfall only gave a denudation rate of one-thirtieth of this.

The fertility of the soil lies in its top crust and the removal of 1.5 inches of the surface soil amounts almost to a disaster. The unproductiveness of newly exposed sub-soil is well known and one might almost say that once the surface has been destroyed fertility has gone for ever as far as the present generation is concerned. It seems to me quite reasonable to suppose that one of the most important factors contributing to the low crop yield in India is erosion by wind due to the absence of wind-breaks. The small amount of study that I have been able to give to this important subject has revealed to me the amazing amount of American literature available on the subject—in itself a proof of the importance attached to it."

LORD LINLITHGOW'S RECOMMENDATION

The Central Board of Irrigation, said Mr. Richardson, was first constituted in 1927, as a panel of all the Provincial Chief Engineers of Irrigation with the Consulting Engineers to the Government of India on which the Central or the Provincial Governments would be entitled to call for examination of a particular project or for report on any specific technical question on which advice was required. Two years later, the Royal Agricultural Commission under the chairmanship of Lord Linlithgow recommended that a Central Bureau of Irrigation should be created, the main functions of which would be to establish and maintain a library of Irrigation publications and to act as a clearing house of information.

This proposal was subsequently amplified and, as a result, the panel was transformed into an active committee meeting at regular intervals with a full-time Secretary in charge of its office, library and information bureau. The Board has provided opportunities for the free exchange of information and experience on irrigation and allied subjects not only between Provincial Irrigation officers but also the officers of other departments. In previous years we have been glad to welcome Agricultural officers at our meetings when matters of common interest have been under discussion and Dr. Burns, Agricultural Expert, Imperial Council of Agricultural Research, is expected to attend our meeting this year. We also will have the help of Dr. Gorrie, I.F.S., in discussing the effects of deforestation.

FIFTEEN MAJOR PROBLEMS

The Board serves a useful purpose in assuring continuity of effort. I find that of the seven major questions considered at the meeting of the Board, no less than six are still under consideration. This is clear evidence of the difficulty of the subjects and, in the absence of a body such as this it is probable that they would not have received continued attention and almost certain that our present knowledge would have been very inferior to what it is.

We are greatly indebted to the engineers and research workers of the Punjab for the fact that the design of weirs on sand no longer figures on our agenda. For the future, the design of such weirs will not be a matter for speculation as it has been in the past and we can

be assured that new works will not be liable to fail without warning as they have done on not a few occasions previously.

For the consideration of this meeting there are no less than fifteen major problems and it is almost certain that the great majority of them will be under discussion for some years to come.

Your Research Committee met informally at Lahore in February this year and there was, of course, the usual annual monsoon meeting in Simla. Your Research Committee has recommended that the cold weather meeting should now be regarded as an established convention. This proposal will be put before the Board for consideration in the course of our proceedings. In my capacity as President, I attended both the meetings and though I am not a research officer I can say with the utmost confidence that I learnt much on each occasion

The question of Central Research will once more come to your attention and a proposal framed by your Research Committee will be put before you. You will be glad to hear that the Government of India have decided that the station at Khadakvasla shall be continued for another five years.

One of the most difficult subjects you will have to consider is the effects of deforestation on irrigation projects. The nomenclature is not satisfactory, omitting, as it does, all reference to erosion and to its effects on agriculture.

You will see from the secretary's report and budget, said Mr. Richardson, that the Board's funds are only just sufficient to maintain our office as at present constituted but we are greatly handicapped and there is a large amount of useful work which remains undone on account of lack of funds.

I have every hope that in due course as the Provincial Governments realise the value of our efforts, they will see their way to increase the present small contributions they make.

The latest Government of India report on Irrigation says that in 1935-36 the value of crops grown under State Irrigation Works in British India alone amounted to 106 crores of rupees. The funds available annually to the Board are only half a lakh of rupees.

That Governments recognise the economic importance of irrigation to India to-day is clear from the number of new projects under

construction or under consideration and I feel certain that this activity will continue in the future at an increasing speed. The Provincial Governments are fully aware of the need for development of the natural resources of their areas and are keen to use these to best advantage. They are ready to admit the need of staff for construction but they are not so ready to admit the need of efficient maintenance.

In the older days with smaller populations and less pressure on the land and less desire for improvement in material conditions, one might be content with the standard represented by a *rabi* duty of 150 acres per cusec. The present standard is much higher and if it is not maintained and improved, the results will soon be evident in great discontent.

But really efficient maintenance requires an adequate number of competent engineers and it will not be possible to secure these engineers unless the rates of pay and conditions of service offered are commensurate with those obtainable by men in other walks of life.

In fact, they should be better, for the life of an Irrigation officer is hard.

His touring is more prolonged and expensive than that of officers in other branches. He is separated from his family for longer periods of time and he is faced with many difficulties in providing adequate education for his children. The same state of affairs applies to Irrigation officials of all grades but it has not hitherto received the attention it deserves.

In conclusion, I wish to place on record my appreciation of the industry and able work of Mr. Gibling and his staff. This is the last Board Meeting for which we shall have the benefit of Mr. Gibling's service and we trust he will take away with him happy memories of four years' strenuous work as Secretary and that he will enjoy the leave he has well earned.—*Indian Information Series,* 15th November 1938.

The following information is taken from the accounts relating to the *Sea-borne Trade and Navigation of British India* for September 1938 :

IMPORTS

ARTICLES	MONTH OF OCTOBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
Siam ..	..	59	32	..	10,187	5,030
French Indo-China	42	..	148	5,042	..	17,612
Burma ..	..	14,800	15,548	..	18,32,851	19,92,811
Java ..	..	..	10	..	..	1,094
Other countries ..	..	58	10	..	9,944	1,695
Total ..	42	14,917	15,748	5,042	18,52,982	20,18,242
Other than Teak—						
Softwoods ..	2,120	2,547	1,078	1,30,973	2,11,726	59,537
Matchwoods ..	648	780	617	38,290	48,035	40,780
Unspecified (value)	..	..	..	27,423	2,74,050	2,68,654
Firewood ..	28	28	55	414	420	478
Sandalwood ..	47	20	3	13,799	10,071	1,920
Total value ..	..	..	..	2,10,899	5,44,302	3,71,369
Total value of Wood and Timber ..	..	..	..	2,15,941	23,97,284	23,89,611
Manufactures of Wood and Timber—						
Furniture and cabinetware ..		No data			No data	
Sleepers of wood ..	..	128	27	..	12,024	9,750
Plywood ..	192	225	461	49,545	46,681	1,02,547
Other manufactures of wood (value) ..	..	..	..	1,21,212	1,26,565	1,82,484
Total value of Manufactures of Wood and Timber other than Furniture and Cabinetware ..	..	..	..	1,70,757	1,85,270	2,94,781
Other Products of Wood and Timber—						
Wood pulp (cwt.)	16,404	15,320	13,598	1,01,454	1,07,102	1,27,888

EXPORTS

ARTICLES	MONTH OF OCTOBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	3,752	40	35	7,79,106	5,000	4,344
,, Germany ..	740	..	..	1,75,867	..	..
,, Iraq ..	30	1	7	4,936	130	2,077
,, Ceylon ..	62	..	..	13,624	..	44
,, Union of South Africa ..	570	..	..	1,15,259	..	..
,, Portuguese East Africa ..	131	..	..	22,051	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	592	66	234	1,41,755	20,522	94,206
Total ..	5,877	107	276	12,52,598	25,652	1,00,671
Teak keys (tons) ..	355	..	..	49,393	..	..
Hardwoods other than teak ..	159	5	..	16,050	1,480	..
Unspecified (value)	..	..	..	69,456	63,325	30,368
Firewood ..	..	..	..	..	..	..
Total value ..	..	..	..	1,34,899	64,805	30,368
Sandalwood—						
To United Kingdom	..	..	..	600	..	..
,, Japan ..	15	10	20	39,828	10,106	20,000
,, United States of America ..	4	64	120	2,300	64,600	1,20,080
,, Other countries	13	23	26	14,625	20,020	25,127
Total ..	32	97	166	57,353	94,720	1,65,207
Total value of Wood and Timber ..	..	..	..	14,44,850	1,85,177	2,96,246
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	15,987	41,609	44,829
Other Products of Wood and Timber		No data			No data	

DOMESTIC OCCURRENCES

Death.—H. G. Billson, C.I.E., I.F.S. (retired), died on 27th October 1938. He passed out of Coopers Hill in 1893, and retired as Chief Conservator of Forests, United Provinces, on the 28th November 1926.

INDIAN FORESTER

FEBRUARY 1939

FOREST DEVELOPMENT

In a recent Travancore Supplement, the *Statesman* published a review of the forest resources of Travancore State written by Mr. S. Kamesam, Director of Development, Travancore.

Mr. Kamesam's main thesis is the superiority for many purposes of treated timbers of miscellaneous species over teak, steel and reinforced concrete. He also urges that timber of all sorts "used as a basic raw material, or as a starting point for being processed either chemically or mechanically" has potentialities so great that very few other raw materials can compete with it. Another statement made by the author of this review is that "the present drive of the Development Department is, therefore, not merely to substitute imported steel and cement with treated non-teak and non-blackwood timbers but to find better substitutes which are cheaper and superior to teak both as regards æsthetic and technical qualities. If the planned and systematic substitution of local 'non-durable' timbers for teak, steel and reinforced concrete is worked to its logical conclusion, it is expected to create a balance of trade in favour of the State of at least Rs. 10,00,000."

Mr. Kamesam is undoubtedly an enthusiast for his subject: a subject which is of deep interest to every forest officer and especially to those who are engaged in research work connected with the production and utilization of timber in this country. Undoubtedly there are considerable potentialities for increased and improved production of timber from the extensive forest areas of India. Travancore State is also specially fortunate in possessing a climate well suited to the production of timbers of the highest class; and still more fortunate in the fact that the State has retained extensive areas of natural forest. The conversion of these natural forests, by scientific management, to a condition of maximum production will be a far simpler and more economic matter than would be the

case had afforestation to be started *ab initio* on barren or denuded lands. The opportunity for development of India's forests undoubtedly exists. The prospects are rosy. The benefits, which India as a whole may hope to obtain, from concentrated and planned development of the potential reservoirs of valuable raw materials in her forests, are great. Such benefits cannot but be of great value to the economic welfare of the people.

Unfortunately, however, enthusiasm alone cannot produce true and lasting prosperity. Discretion and knowledge must build strong foundations upon which enthusiasm can raise its paradisial palaces for the peoples of India. It behoves us, therefore, as the mouthpiece of organised forestry in this country, to sound a note of warning and to urge most strongly that those upon whose shoulders rests the ultimate responsibility for the future welfare of the peoples of this country, shall not forget the old adage that all is not gold that glitters. We do this in no carping spirit. We admire Mr. Kamesam's enthusiasm and wish him every success in his numerous and bold projects. No good can come, however, from ignoring facts which are founded on much laborious scientific research, as well as upon the accumulated knowledge, gained through more than half a century of practical experience and carefully recorded in the *Indian Forester* and other publications by several generations of forest officers, who have been acknowledged throughout the world as leaders in their profession.

Mr. Kamesam says that "in the light of modern scientific data, it is clear that teak is a very poor furniture wood." We have no hesitation whatsoever in saying that this statement, as it stands, is totally and absolutely incorrect. Teak, except in appearance, ranks as one of the world's best furniture woods on account of its "steadiness" (that is to say, its low co-efficient of expansion and contraction) and its durability. There are no "modern scientific data" to support a contrary opinion. We could have agreed with Mr. Kamesam had he said that other woods may be more decorative. But for general utility furniture there are very few woods which can be classed with teak, and, if a proper selection is made, some teak can be extremely beautiful. Teak is, and will always remain, one of the world's finest timbers for a very large variety of purposes.

Mr. Kamesam proposes to release half a million cubic feet of teak and blackwood for profitable sale in British India, by bringing into use in the State "porous and rapidly perishable timbers" after these have been treated with preservatives under pressure. "The Public Works Department has," he says, "been employing teak for several purposes where the use of other better timbers are not merely indicated but are considerably cheaper." In utilising existing stands of timber, cost is usually primarily dependent upon charges for transport and it may be questionable whether timbers of other species, which must bear the additional costs of preservative treatment, will in actual practice be any cheaper than teak which needs no such preservation. This, however, can only be decided in the light of local circumstances and doubtless Mr. Kamesam has satisfied himself that his statement is correct as regards the stands of timber already existing in Travancore. There is, however, another aspect of cost which must be taken into account in exploiting timber and that is the cost of replacement. Mr. Kamesam himself emphasises both the necessity for observing sound silvicultural practice and the fact that timber is a long-term crop. He couples these points, however, with the statement that "timber is inexhaustible." Unfortunately, existing stands of timber can be only too quickly exhausted unless adequate regeneration can be assured whenever and wherever desired. "Orthodox forest officers" have learnt, often to their bitter disappointment, how difficult it may be to fulfil this essential proviso with many of those species which have hitherto not been largely marketed simply on this account. It is in this matter of simplicity and consequent cheapness in regeneration that teak scores so heavily against its competitors. Teak plantations can nowadays be raised, under suitable conditions of soil and climate, with 100 per cent. success, and at a very low cost, by putting out "stumps" in lines between field crops. We do not wish to suggest that teak is in any way utterly unique: merely that it is hard to beat, as, incidentally, is shown by Mr. Kamesam's own expectation that he can continue to export it at profitable prices.

Nor is it ever likely to be "an expensive and useless luxury to grow trees beyond a diameter of 13 inches to 14 inches." The most profitable diameters up to which to grow timber depend, apart

altogether from questions of conversion, upon the rate of volume increment which the trees put on annually. This is a matter which can easily be translated into terms of ordinary financial investments. So long as the rate of interest (increment) accruing upon any investment (plantation) continues at a reasonable rate it is not sound business to convert that investment into cash which needs again to be invested. Moreover, it is an elementary fact of timber utilisation that a large log can be more economically converted than can a small one. It is definitely uneconomical, for example, to convert small trees into plywood. The minimum diameter considered to be economical for rotary peeling is about 18 inches. An average diameter of between two and three feet may be considered satisfactory, but any plywood factory would be only too pleased if all its logs were over three feet in diameter.

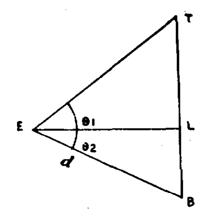
A READY REFERENCE CHART FOR ABNEY'S HEIGHTS

By N. C. Roy,

Silvicultural Branch, F. R. I.

Preliminary Remarks.—The chart, as devised, enables quick determination of heights on the spot from the angular measurements with Abney's Level or similar other instruments and eliminates calculation work altogether.

In measuring heights with Abney's Level the following observations are taken:



θ_1 = angle observed to the top of the tree B T.

θ_2 = angle observed to the base of the tree.

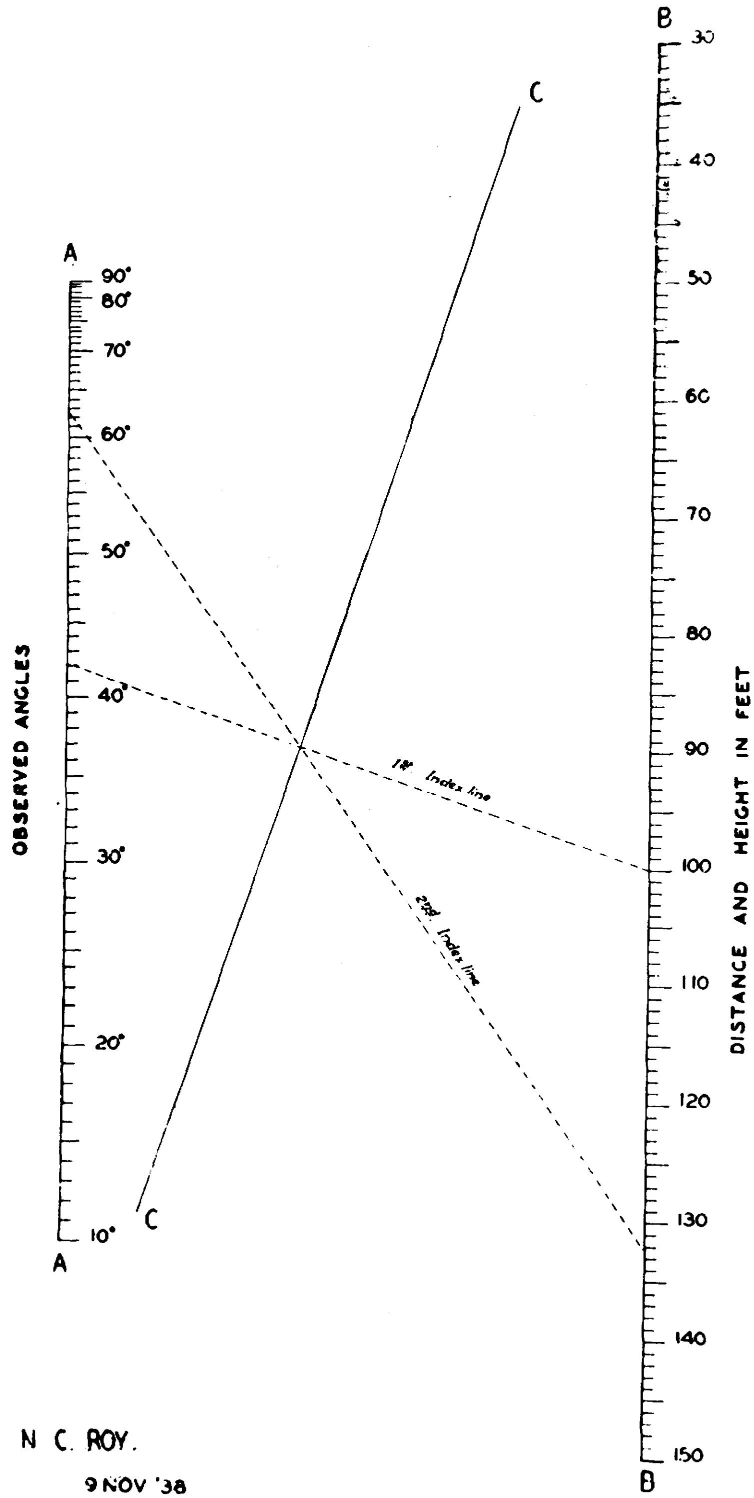
d = distance in feet of the eye-piece of the instrument from the base of the tree.

$\theta_1+\theta_2$ = the sum of the observed angles.

The Chart.—AA, BB are two vertical parallel axes taken at a convenient distance and CC is a transversal.

On the axis AA are marked angles in degrees and on the axis BB heights and distance in feet. Intermediate graduations of 10' minutes in AA and 1/10 ft. in BB can be fairly accurately estimated with a little practice.

READY REFERENCE CHART FOR ABNEY'S HEIGHTS.



Method of reading.

Place the straight edge of a rule or a transparent celluloid set-square on $(90 - \theta_1)^\circ$ on the axis AA and d on the axis BB (1st index line). Mark with a soft pencil its point of intersection with the transversal CC. Now put the edge of the set-square on this point of intersection and the sum of the observed angles $\theta_1 + \theta_2$ on the axis AA (2nd index line). The point, where the edge of the set-square intersects the axis BB, gives the height required.

Notes.—(*i*) If both the angles are observed from a point below the base of the tree, θ_2 should be taken as negative and the algebraic sum of the observed angles $(\theta_1 - \theta_2)$ should be taken.

(*ii*) If d is horizontal, $\theta_2 = 0$ and the sum of the observed angles $= \theta_1$.

(*iii*) If θ_2 is observed to the cross mark or to any other height on the tree then that height should be added to the height read from the chart to get the total height.

An Example.

$\theta_1 = 47^\circ\ 50'$, $\theta_2 = 14^\circ\ 40'$, d $= 100{\cdot}0'$, θ_2 observed to cross mark at $4\frac{1}{2}'$ from the ground level.

Then $90^\circ - \theta_1 = 42^\circ\ 10'$.

$\theta_1 + \theta_2 = 62^\circ\ 30'$.

Height read from the chart $= 132{\cdot}4'$

Height of the cross mark from ground level $= 4{\cdot}5'$

Total Height $= 136{\cdot}9'$

Calculated ,, $= 136{\cdot}6'$

The accuracy of the use of this alignment chart in calculating heights has been tested for a number of trees and the error in no case exceeded 0.8 per cent., which is small compared with the other errors involved in using an Abney's Level for measuring the height of trees.

Note.—Photographic copies of this diagram 13½ inches by 7½ inches may be obtained from the Central Silviculturist, Forest Research Institute, New Forest P.O., on payment of Rs. 1-2-0 each to cover cost of photography.

UTILISATION OF FOREST WEALTH

FORESTS—THEIR INFLUENCE AND THEIR ROLE IN THE ECONOMIC RECONSTRUCTION OF THE COUNTRY.

BY RAO SAHIB S. RANGASWAMI, RESEARCH RANGER, DENKANIKOTA.

(A Paper read at the Salem Khadi Swadeshi Exhibition on 18th August 1938.)

Summary.—The different classes of forest wealth, the forest areas in different countries, love of forests of the Japanese and the various advantages gained by all the Departments by forests are fully detailed. The prejudice against the Forest Department prevailing in the country, its cause and remedy, are explained. The importance of forest conservation in its relation to agriculture is fully explained. Various industries that can be developed by utilising forest resources are indicated. The possibilities of cultivation of medicinal plants and manufacture of various medicines explained as also the various uses of lac in different industries. Suggestions for exploring the mineral wealth of forests are given.

Forests are National Assets.—"Forests are national assets" is an old maxim. If Forests are destroyed the whole country will suffer. Fodder, grass and tanning materials for leather were supplied on a vast scale in the Great War of 1914—18 from the Deccan forests and even last year and the year before, the fodder famine in Anantapur and Bellary Districts was relieved by the supply of fodder obtained from the forests. Very few of us realise to what extent we depend on forest for our necessities of life. The possibilities of manufacture from the raw materials yielded from the forests are unlimited.

The other great advantage in having forests in a country, especially a hot one like ours, is the moderation in climatic factors. How glad one feels to go under a tree from the scorching sun. The mere existence of forest growth modifies temperature and rainfall.

Prejudice against the Forest Department and its Cause and Remedy.—Still in our country, where, once upon a time the forests were worshipped as a goddess (Vanadevata), a strong prejudice has arisen against the department and frequently many public-spirited gentlemen consider that no government department is necessary to carry on the administration.

This is because Forest Officers have to work in remote parts and always away from the eyes of the public. They generally devote their time to the forest conservancy and the development of various products. All supplies to the public are met by contractors or

other middle men to whom the forest products are generally sold. The only occasion on which the Forest Officers come to the forefront is generally in Magistrates' courts when someone has to be prosecuted for illicit grazing, pilfering, etc., where the public, including lawyers, think that the duties of the Forest officers are confined only to this type of work.

This handicap can easily be removed by the Department undertaking to meet the requirements of the public directly instead of through middle men, even though the latter procedure is not free from its attendant evils. People will then realise to what extent they have to depend on forest resources and what kind of protection is essential to safeguard and regulate these.

Forest Areas in Different Countries.—In Finland, a very small country, 73.5 per cent. of the land area is covered by forests as compared with about 15 to 20 per cent. in India. I may tell you how Japan views her forests. It is one of the most densely populated countries in the world carrying 358 persons to the square mile. In this regard she is exceeded only by Belgium with 702. It is to be realised that with such a dense population the fullest and most efficient use of the land for food production is essential and in travelling through Japan one finds that everywhere most intensive cultivation is the practice. Nevertheless 55.7 per cent. of the total land area is kept under forest to supply timber, pulp wood, fuel in the form of charcoal, etc. A considerable area of the forest is reserved mainly to ensure regularity of stream flow and prevent soil erosion and landslides. In addition about 20 per cent. of the land is kept as scrub jungle reserved for forestry purposes. Thus 67.2 per cent. of the total land area is kept under forests without a grudge.

Forest Sense in Japan and India compared.—Wood is more generally used by the Japanese than by any other people of the world. Though in recent years, concrete and steel are used for public buildings, still wood alone is used for private houses, shops and other structures. It must not be thought that these wooden buildings have a short life. The contrary is true. Several of the wooden temples in Japan which are over 5 centuries old have had only slight repairs at long intervals.

Japanese Love for Forests.—In using wood for their houses the Japanese are not actuated by considerations of cheapness. They use wood mainly because they have an artistic preference for it. The grey velvety appearance gained by the weathering of well dressed timber is pleasing to them. The Japanese have an innate reverence and love of trees and they look upon groves of trees as temples of nature. Around all temples and shrines, trees have been planted for beautification and the enhancement of the holiness of the locality. Leading to the celebrated Nikka shrine there is an avenue of giant Cryptomerias which is over 30 miles long. This avenue is one of the tree wonders of the world. It was planted 300 years ago by a Japanese gentleman who thought he was too poor to offer a more costly tribute. Except for Taj Mahal, it is the most beautiful and lasting memorial ever created by man.

We had also such love for our forests in olden times but it is waning due to our new civilisation. It is now our duty to revive the waning love and reverence for our forests.

Influence of Forests on Rainfall and Soil Conservancy.—People generally complain there was plenty of rain in olden times and they got whatever they wanted from the forests free of charge without causing any deterioration to the forests. They forget the fact that in those times the population was limited perhaps due to frequent wars and the demand on the resources of the forests was very much less than the production.

Now the population has increased by leaps and bounds and the demand on the forest resources has also considerably increased. But for the incoming of the Forest Department the fate of the Reserve Forests would have been the same as unreserves and patta forests wherein we see bare rocks all around us.

Forests do not produce rain but retain the fallen rain.—I heard the other day that some people passed an opinion that even the Sahara desert gets outbursts of rain. Though the very word "desert" signifies a place of poor rainfall, yet we should understand that forests do not produce rain. You certainly get rain even in desert regions and even in places of rocky outcrops but forests preserve the rain after it has fallen. No matter how heavy or poor the rainfall, a very large part of it is delayed by this surface mat of vegetation and passed downwards through the porous layers to the rock

cavities and underground storage reservoirs which are the chief support of perennial springs.

Ill effects of Forest Destruction.—Anything which interferes with the porosity of the soil or with the healthy condition of the plant cover, must inevitably affect the percentage of rainfall which finds its way underground. Of the various factors affecting the plant cover, such as cleaning of grass land or forest, by burning or felling, ploughing, grazing, etc., grazing probably is the most widespread and most insiduous. Constant heavy grazing by underfed animals such as occurs on village common lands throughout India, leads inevitably to the thinning out of the vegetation and to compacting the soil into a solid mass, so that the reduced cover is less capable of checking the surface run-off and the altered soil profile is less capable of absorbing it. The amount of erosion and its effect upon the water regime caused by this state of affairs in sloping lands are clearly shown by some data of torrent intensity which have been collected in an arid tract of low hills along the eastern bank of the *Jhelum* river opposite to the cantonment and city of *Jhelum.* The *Pabbi* is a low ridge of heavily eroded *Siwalik* sandstone and shale and shows a variety of conditions of plant cover. The run-off or rather the peak of flood discharge for a large number of separate torrents has been collected by the Irrigation staff.

(1) Part of the area has been under a regime of afforestation and counter-erosion work for about 50 years; such land, although not yet fully covered up with the vegetation, yields a maximum run-off of less than 100 cusecs per square mile (a cusec is a measure of the rate of flow: about 30 gallons of water per second).

(2) Similar land under a passive regime of protection against grazing but with no active afforestation or erosion control work yields a maximum of 600 cusecs per square mile.

(3) Similar land under grazing partially but ineffectively controlled yields 1,000 cusecs.

(4) Where persistent cattle and buffalo grazing has destroyed the cover and reduced the area to the relics of scrub jungle, the run-off rises to the alarming figure of 1,600 cusecs per sq. mile.

The last figure represents an extremely high percentage of run-off in the neighbourhood of 90 per cent. of the rainfall for the

typical sudden torrential downpour falling on ground previously parched up by drought.

Benefits conferred on People by Forest Conservancy and Protection.—A certain number of individual persons and even corporate bodies always agitate that people should be given free grazing, fuel and manure leaves. Certainly the Forest Department should sympathise with such demands but, at the same time, it is the duty of the Department to point out the Forest Policy with regard to Reserves, *i.e.*, they should fulfil functions essential in a national sense of which many are conscious. The benefits from forests such as their water conservancy effects and their utility as sources of essential produce are not afforded merely to dwellers close to forests but to the populace at large, far away from the forests. The Forest Department endeavours, in face of such pilfering and destruction, to protect and improve the forests regulating the removal of produce. If this is not done our future generations will possess very little forests which are always realised as a very valuable inheritance. Every one of us especially in our own Salem District is aware of the rapidity with which the vegetation on the unprotected hills around us has disappeared.

Forest Benefits on Two Classes of People.—Therefore you should all realise that the forests are of national value and two classes of people are concerned in them—one class are those living close to forests who could easily have the free enjoyment of forest lands for which they agitate. The other class which is probably five times as numerous—have equal national interest in the Reserve Forests but live too far away to benefit, if free rights of enjoyments of forest produce were granted. About 4/5ths of the population would be sufferers by the diminution of the forests—caused by excess exploitation—without enjoying the appreciable temporary benefits themselves during the process of forest disappearance. However, the Government have recently given a concession to the ryots by reducing the grazing fees by 60 per cent. Free grants of small timber, bamboos, etc., are also given to the villagers whenever they are affected by unforeseen causes such as flood and fire.

Different Types of Forest Wealth.—You should know the forest wealth is immense and three main classes are concerned in them.

(*i*) The vegetative wealth.

(*ii*) The mineral wealth, and

(*iii*) The animal wealth.

All these form storehouses for various industries requiring enthusiastic individuals and firms to come forward to develop them.

Educative value of Forests.—The forests are educational institutions of great value especially in *Botanical, Zoological* and *Mycological* aspects and they are natural parks of high aesthetic value for the public to enjoy.

The forest is considered to be the handmaid to agriculture and I can assure you that she is the handmaid to every department. It is the storehouse for all kinds of timber which is the basis for 6 main fields of commercial exploitation:

Industrial uses of Wood—

(*i*) as a structural material in almost every field of engineering application,

(*ii*) as a paper making and textile medium,

(*iii*) as a valuable medium for heating and lighting,

(*iv*) as a cheap, efficient and universal source of power for stationary as well as moving engines,

(*v*) as a basic material for food and fodder,

(*vi*) as a new material for important chemical by-products.

Several cottage industries can be developed on the above lines to employ the rural population.

In America and elsewhere there is a fuller utilisation by invoking the aid of the latest discoveries of science. Sawdust is converted into "Sacchulose" useful for the distiller and agriculturist. Wood chips are exploded into "synthetic lumber." Wood cellulose is made to yield artificial silk. Recently a new packing material has come forward in the form of wood fibre blanketing or matting from waste lumber.

Transparent sheets of cellulose are now being used for making laminated "glass" which is bullet-proof. Chemists hope to get glucose from wood and very soon even our breakfast may consist of material got from pieces of wood.

II. Let me now deal with the development of some of the industries.

Lac Industry.—Taking now the lac industry in which I am trying to specialise to a certain extent I can tell you that it has got a

high potential value. Lac is a resin obtained from the secretion of an insect living on certain trees. British India has the virtual monopoly of the trade in lac—Siam, Federated Malay States and Indo-China contributing about 3 per cent.

Two-and-a-half centuries ago, a member of the Jesuit Order, Father Tachard, published the first account of the lac insect responsible for products now exported to the extent of 32,000 tons a year, with a value in normal trading conditions of over 30 million pounds sterling. Lac is therefore a very old member of the group of plastic resins.

Lac Dye.—Lac yields two distinct products—a dye and a resin. In the 16th century the value of the resin was not fully realised but a large trade in lac dye sprang up and numerous factories came into prominence for pressing the dye into cakes and marketing. The trade in this product attained such importance in the 18th century that the resin from the lac was almost relegated to the position of the unimportant by-product.

The discovery of aniline dyes by Sir W. H. Perkin and the perfection of chemical dyes put an end to the lac industry. By this time the importance of the resin had been realised in Europe and methods and directions of using it had been discovered. The importance of the industry from being that of dye production became that of resin production and the dye, formerly the main product, took the position of a minor by-product of the resin factory and it is the resin both in its unmanufactured form and in the manufactured form, *i.e.,* shellac, which now mainly comprises the industry.

Evils of Unregulated Supply in Lac.—The industries in which lac enters are extremely numerous and diverse in character. The most important are the gramophone industry, electrical and varnish trades and the manufacture of munitions and exploders. As I have stated already 30 million pounds worth of lac are annually exported to the United Kingdom, America, Germany, Italy, and other parts of the Continent. During the Great War the demand for lac was far more than the quantity that was available for the supply. The price per maund of lac which is now about Rs. 20 rose up to Rs. 120. This high price was taken advantage of by some unscrupulous traders and they started adulterating the shellac with rosin and other such

substances and thus made the stuff, that was available, unsuitable to various industrial purposes. The other countries started experimenting to find out a suitable substitute for lac. I may tell you that in America alone, several millions of pounds have been spent in establishing Research factories to produce the synthetic substitute and have succeeded in producing a substance almost like lac.

Lac in Gramophone Industry.—The gramophone industry alone consumes about 50 per cent. of the present output of lac in India. Though this quantity may decrease due to competition from substitutes and also to the introduction of new methods of sound recording, yet the high class gramophone records made of lac are still undoubtedly the best.

Lac in Electrical Industry.—In the electrical industry, lac products are chiefly employed as insulating varnishes, as a binding material for laminated insulating materials such as paper boards, paper tubes, etc., and also for bonding mica sheets. It is also used in binding cement for basing electric light bulbs and wireless valves.

Lac in Paint and Varnish Industries.—The varnish trade mentioned in connection with the electrical industries covers a much wider field but the principal section is the paint and varnish industry and together with the electrical industry is one in which competition from synthetic substitutes has not made much progress.

There has therefore been a move towards combining the use of lac with the substitutes in lacquers (to bring down the cost of production) which should once more develop an extended trade in this field. At present the electrical, paint and varnish industries together consume about 35 per cent. but we should all remember the rate of increase in electrical industry is doubling every year and be prepared to meet all demands.

Lac in Plastic Mouldings.—The next important industrial development in the last few years is in the moulding plastic industry. This is concerned with the manufacture of such articles as ash trays, camera cases, fountain pen cases, switch covers, and a multitude of similar commodities with which the name Bakelite is generally associated. This industry which has been built up by the energy of synthetic resin sales organisation offers a very hopeful field for extending the use of shellac. One of the disadvantages of the usual type of shellac moulding is its poor heat resistance. Research carried out

in this direction at Ranchi has proved that shellac when "heat cured" at a given temperature at 110°C. can be fused if heated rapidly, *i.e.*, at 190°C. and therefore gave a moulding which did not blister when placed in an oven 130° C.

Moulding powders which have properties very similar to Bakelite can be prepared very cheaply from shellac and its by-products.

The resin content of lac can be divided into an ether soluble and an ether insoluble portion. The ether insoluble portion which forms 75 to 80 per cent. of the whole is known as pure lac resin and is found to have a quicker thermo hardening, is extremely water resistant and as a varnish gives films remarkably hard, flexible and adhesive without the use of Plasticisers. Several commercial processes are being developed to isolate this pure resin.

Lac in miscellaneous Industries.—The other industries which consume a quantity of lac are:

1. Polishes of different kinds such as French polishes, floor varnishes, silver and brass finishers polish, steel lacquer, sculpture varnish, photographic negative varnish, waterproofing solutions, straw hat varnish.

2. Sealing wax of different grades, bottle wax, deed wax, etc.

3. Varnishes for leather and shoes such as leather polishes, leather plastic to resole shoes, waterproof dressing for shoes.

4. Inks such as lithographic inks, marking inks, stencil inks, ink for writing on glazed card-boards, indelible drawing inks, etc.

5. Paints such as black-board paints, aluminium paint, anti-fouling compositions for ships bottoms, etc.

6. Cements and glues for celluloids, leather and rubber articles and paste for envelopes.

7. Waterproof stiffening for straw hats and black straw hat varnish, etc.

I have enumerated some of the above industries just to show you what possibilities there are in this line.

Charcoal Industry—Production of Motive Power.—The present waste material, *i.e.*, the charcoal powder which can be obtained by burning all slash going waste in our forest areas is briquetted, that is, by mixing with a gummy substance and pressing into big pieces of the ordinary charcoal size. Apart from its use for smokeless fire, which is now very much preferred by our modern ladies for cooking and heat-

ing purposes, it has got great potential value as a source of motive power for vehicles. Air is drawn through it whilst it is in a red-hot stage in a special container. Carbon monoxide gas is formed and this is mixed with air in the carburettor and burned in the cylinders in the ordinary way. The world's supply of petrol is limited; and India herself produces little if any. But charcoal can be supplied perpetually by the forests and vehicles propelled by it are increasing in numbers in Germany and Italy. It is also proposed to have charcoal-driven lorries for cheap transport of sandalwood in this Presidency.

Medicinal Plants.—The next important industry is in developing the Indian medicinal plants. The Indian systems of medicine have been regarded by many of the western scholars interested in oriental studies as a rich mine of knowledge from which many useful things might possibly be unearthed. It has been said that "the medicine of India was permeated with the scientific spirit, as evidenced by a desire, by observation and experiment, by induction and deduction, to probe the secrets of nature and to build thereon a national system of medicine." India is so climatologically situated that almost every kind of medicinal plant is grown in some part of the country or other.

Exports and Imports in Medicines compared.—Let me now point out something about the drug trade in India which will show its economic importance. The total value of imports and exports during the last 35 years discloses some remarkable facts. Both the imports and exports have considerably increased in the last 35 years. In the year 1908-09 the value of drugs exported from India amounted to 15½ lakhs of rupees while the imports came up to 70 lakhs, but now the export amounts to 42 lakhs of rupees worth of material, while the corresponding imports is for Rs. 200 lakhs. A close scrutiny reveals that the imports are proportionately very much larger than the exports. This means that while much raw material is going out of the country, very considerable quantities of refined preparations manufactured in foreign countries are coming into the Indian market. The drugs imported consist mainly of pharmaceutical preparations, in many cases manufactured from the raw materials that have been exported. A list of different drugs given in the sea-borne trade returns for India contains plants such as *Aconite nepallus, Alstonia*

scholaris, Atropha belladona, Arachis hypogea, Anogeissus latifolia, Berberis aristata, Butea frondosa, Cannabis indica, Caesalpinia bonducella, Datura fastuosa, etc. It is unnecessary to give you the long list especially when the local vernacular names and their uses could not be detailed in this short lecture. It is found from the list that all these drugs in crude forms which are annually exported to foreign countries at a nominal price, are utilised in various medical and allied industries and a portion of them, at any rate, is returned to our country in the form of expensive preparations. The finished products naturally fetch considerably higher prices and hence the increase in export revenues only shows to what an extent our raw products are being utilised by the drug manufacturers of other countries to their benefit and to the economic loss of our country.

Solving Unemployment by Development of Medicinal Plants.—The drugs are many in number and varied in character and the process of inquiry is long, tedious and laborious. At present the identification of the drug plants is the prime difficulty and for this we want a number of good botanists. Next we want a number of pharmaceutical chemists. You may easily imagine the amount of labour that will be required for collection of these drugs alone, apart from chemists and botanists.

Supply of Medicines to the Rural Population.—The next proposition is to devise methods for effecting economy, so that these medicines may reach the masses. This is possible only if the price of drugs can be considerably reduced; for in a poor country like ours there are millions of people who cannot afford any kind of treatment, whether cheap or expensive and have to depend on charitable medical relief institutions. The cost of drugs is so heavy and the budget of the institutions so low they are not able to cope up with the demand even for common and essential drugs as quinine, castor oil, magnesia, etc. By encouraging the production, collection and manufacture of all imported drugs in our country alone not only will we be solving to a certain extent the unemployment problem but improve the economic status of our country and bring medical relief to all our brethren either rich or poor.

The cultivation of medicinal plants not available in India may also be undertaken especially by the Forest Department.

I may once more emphasise the point that the drug resources of India are vast and inexhaustible and it can be said without exaggeration that India could supply the whole of the civilised world with medicinal plants and herbs and it requires only the aid of Government or public bodies to organise the department and carry out the collections and conversion.

Development of Plant for Pharmaceutical Factories.—Now there is a pharmaceutical factory established in Calcutta and over 90% of the machinery required for pharmaceutical factories is at present being imported from America and Europe. Pharmaceutical appliances such as percolators, tincture presses, vacuum stills, emulsifiers, tablet makers, pill machines, etc., are all imported from foreign countries. With a little organisation all these could be easily done in India and at much cheaper prices.

Industrial Development of other Forest Products:—Tans and Dyes.—Tans and dyes are the next important industry. Tannin is an organic substance having the property of combining with albumen and gelatine to form an insoluble compound to resist decay. Raw hides treated with tannin thus get converted into leather. Its other property of reacting with iron salts giving a black substance is made use of in the manufacture of inks. It occurs in barks of certain types, in fruits, leaves, etc., of various species which require development.

Perfumes.—Perfumes from flowers, grass oils and wood oils such as sandalwood oil. Distillation of these oils used in perfumery and soap making has also got a great future before it.

Animal wealth.—Animal wealth is also vast consisting of hides, horns, bones and ivory.

Mineral wealth.—Our forests are rich in mineral wealth but require a careful survey by experts. The existence has been proved by the discovery of barium sulphate in Anantapur, manganese from South Cuddappah, aluminium silicate in Salem North, magnesite in Central Salem and mica in Nellore.

Appeal to the General Public.—In conclusion, I wish to reiterate the fact that though we are blessed with all kinds of raw materials suited for various industries, it is a pity we are not utilising them to the fullest degree. It may be that our attempts in one or two

lines may be failures either fully or partly yet I may tell you, as Sir M. Viswaraya pointed out the other day, that we should be prepared to take risks and without taking risks we cannot succeed in establishing any of the industrial concerns.

I therefore appeal to one and all of you to co-operate with the Government in conserving forest wealth and utilising it to advantage.

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A NOTE ON HYPARRHENIA GRIFFITHII BOR

The object of this note is to give a description of this plant in English and also to furnish a plate, which, unfortunately, due to a variety of circumstances, could not be included in the List of Assam Grasses published as an Indian Forest Record (Botany), Vol. I, No. 3, 1938.

Hyparrhenia griffithii Bor. Indian Forest Records (Botany), Vol. I, Part 3.

A perennial grass from a creeping rhizome; culms erect or slightly geniculate, slender, glabrous, up to 2 m. tall, innovations intravaginal, leafy; basal sheaths carinate, persistent, glabrous, upper slipping from the culm, terete, glabrous or with a few white hairs, very hairy when young; margins often ciliate, throat hairy; ligules membranous, convex upwards, up to 2 mm. long; leaves linear from a rounded contracted base, tapering to a very fine point, glabrous on both surfaces or covered with soft white hairs when young; median nerve white, prominent; margins minutely scabrid.

Ganga Singh.

HYPARRHENIA GRIFFITHII BOR

1. Whole plant.
2. Sessile spikelet with two pedicelled spikelets at tip of raceme.
3. Lower glume of sessile spikelet.
4. Upper glume of sessile spikelet.
5. Lower lemma of sessile spikelet (opened out).
6. Upper lemma with awn.
7. Palea of upper lemma.
8. Common peduncle of the two racemes, covered with tubercle-based hairs.

Inflorescence a compound, spatheate panicle up to 35 cm. long, contracted; branches erect, strict, filiform issuing from lanceolate to linear, setaceously-acuminate spathes, which are up to 15 cm. long; spatheoles narrow, 3-4 mm. wide, linear, convolute, 4-6 cm. long; common peduncle filiform up to 4.5 cm. long, shorter than the spatheole, glabrous and smooth below, covered in the upper quarter with 4 mm. long white hairs from tubercle bases, enclosed in the spatheole until anthesis, afterwards emerging.

Racemes in pairs, epinastic after anthesis, unequally peduncled (longer peduncle 3 mm. long), 2 cm. long; peduncles bearded at the base; joints and pedicels filiform, up to 4 mm. long, flattened, densely ciliate, tip expanded and very oblique. The lowest pair, or two lowest pairs, of spikelets homogamous, male or neuter; heterogamous spikelets 2-3 pairs, the sessile hermaphrodite, the pedicelled male or neuter. Callus acute, bearded.

Homogamous spikelets ovate-oblong in shape; lower glume 6.5 mm. long, up to 11-nerved, 2-toothed, one tooth being extended into a short bristle or not; back rounded or flat; nerves with long white hairs; upper glume 6.5 mm. 3-4-nerved, oblong-lanceolate, rounded on the back; margins long, ciliate. Lower floret barren; lemma narrow, 6 mm. long, hyaline, ciliate on the margins. Upper floret; lemma ovate-lanceolate, hyaline, margins ciliate at the top; palea minute, sometimes containing a rudimentary ovary and stamens or stamens only, usually empty. Stamens, if present, 3; anthers 4 mm. long.

Sessile spikelets narrowly elliptic-oblong in shape; lower glume 5-5.5 mm. long, truncate, 2-toothed, back slightly rounded below, flat or shallowly depressed above, 5-9-nerved; margins involute, nerves covered with stiff white hairs up to 4 mm. long; upper glume lanceolate, oblong, sub-acute, 6 mm. long, keeled, depressed on either side of the keel, 1-3-4-nerved, scabrid on the keel and pubescent on the sides at the top. Lower floret barren; lemma linear oblong, 5 mm. long, obtuse, hyaline, ciliate on the margins at the top; palea absent. Upper floret hermaphrodite; lemma 4 mm. long, linear, concave, translucent, margins carried out into two subulate teeth, awned; awn slightly narrower than the lemma; column 2 cm. long, dark brown, hispid with rufous upwardly-directed hairs, remainder 2 cm., antrorsely barbed; palea, if present,

minute. Stamens 3; anthers 2.5 mm. long. Ovary ovoid; stigmas 2. Grain terete, 4 mm. long.

Pedicelled spikelets barren, narrow, linear-lanceolate in outline, lower glume 9-11-nerved, flat on the back, 2-toothed or one tooth extended into a barbed bristle 2.5 mm. long; upper glume lanceolate, rounded on the back, 3-nerved. Lower floret absent or represented by a very narrow hyaline lemma; palea if present minute, truncate; upper floret; lemma, hyline, ovate-lanceolate, ciliate; palea if present minute, truncate.

This grass covers large areas in the Synteng country north of Nartiang, Khasi and Jaintia Hills.

Flowers in November-December.

RESIN TAPPING IN KUMAON

BY F. C. FORD ROBERTSON, B.SC., I.F.S.

PART II.—NOTES ON RESEARCH AND SOME RECENT FIELD STUDIES BEARING ON FUTURE RESIN SUPPLY.

Abstract.—Indian resin research to date hardly commensurate with the industry's importance. Recent field studies in light tapping, as practised since 1916, confirm fears of premature exhaustion, indicating that tapping life expectancy of the smallest tapped trees must be shortened from 70 to under 50 years and for typical coupes to less than 60 years, considering all decremental factors. The implications for future resin management discussed, with suggestions for modifying both tapping method and somewhat *laissez-faire* silviculture.

29. So little research into resin problems has yet been done in India that the smallest advance is endowed with more than ordinary interest. Since H. G. Champion's "Investigation of certain factors concerning the Resin-tapping Industry in Pinus longifolia," published as long ago as 1923 in Forest Bulletin No. 51, the U.P. has initiated only one large-scale experiment—an investigation into the yields obtainable from three depths of channel in straight-grained and twisted *chir* forest. This, after a six years' run, will shortly be written up and it is no rash anticipation of its results to say that these are likely merely to confirm, and embody in quantitative form, conclusions long since arrived at by ordinary field experience. As for the Punjab or Kashmir—if they are starting to make their contribution to our sadly deficient pool of knowledge, I have yet to hear of it.

Fig. 13 and 14.—" . . . vagrant or conflicting channel systems."

Fig. 15.—A particularly bad cripple, useless for timber or fuel and of small resin potentiality. It has cumbered the ground for a couple of centuries.

Fig. 16.—" . . . fire damage . . . in terms of scorched and ruined callus . . . "

Fig. 17.—" . . . crooked, fantastically twisted or otherwise crippled and defective individuals."

Fig. 18.—" . . . poorly tended, generally ill-stocked, irregular forest . . . "

Fig. 19.—" . . . depauperating, even to erosion, the forest soil that should nourish our trees." Note the "hoof-terracing" and, in the foreground, incipient erosion.

The above three photos, taken from reserves 30—40 miles apart, illustrate characteristic gradations in forest condition and quality: test counts show channel stocking varying from 18 to 23 per acre and a common impoverishment due to gross overgrazing, regular burning and a systematic removal of all needle litter (**pirul**) and fuel by villagers.

30. There is so much we still want to know. For example, would a worth-while increase in yield result from altering the freshening frequency according to the season (which our tappers do—only rather blindly), to site factors like aspect and altitude, and to size and vigour of the tree? And if so, what degree of differentiation could be enforced in the field? Does channelling to 4 inches broad with $4\frac{1}{2}$ inch interspaces—dimensions borrowed from another country for another sort of pine—represent optimum tapping practice for *chir*? And, two questions allied to this; what is the most profitable way to tap out a tree in, say, five to ten years? and how will tapping between the present faces, *i.e.* interspatial tapping, affect the yield—and the tree?* Again, what is the effect of our modern thorough *kurchan*, which must raise the temperature of the peripheral tissues, on resin production? Would it be practicable and paying to tap higher up the stem, as both the French and Americans do, possibly employing a compromise between their two types of face? These and others are questions of practical import to this busy, remunerative industry of ours, yet they seem likely to wait long for an answer.

31. Another point of no less moment has recently been the subject of a small, quite unofficial experiment in this division. Begun on his own initiative just before I took over charge, by Pandit Vachaspati Nautiyal, R.O. Someswar, whose research experience under the Central Silviculturist at Dehra Dun prompted this praiseworthy effort, the experiment compared yields of the 1937 season from comparable sets of trees (*a*) tapped in standard fashion and (*b*) re-tapped, *i.e.,* previous year's channel deepened, to a depth of 2 inches. Full details of the lay-out and procedure cannot be given here but these were satisfactory enough to make the comparative results impressive and worth pursuing on a larger scale: the yield from re-tapping came to about 90 per cent. of the yield obtained by standard tapping practice. If this result has anything like general validity—and the matter is being followed up—its importance for resin divisions needs no emphasis. The more so for certain considerations I wish now to discuss.

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*See forward, paragraph 52.

32. Earlier in this article I indicated our growing concern in the United Provinces over how long our more accessible, and therefore longest tapped resin coupes would last us. Punjab readers may here be reminded that we begin tapping at 3½ feet bhg.; and readers in general, that this problem is one peculiar to India. Poor demand and other factors combine to saddle us with long rotations (100 and 120 years in Kumaon) and the drag of perforce neglected thinnings —thinnings that would boost our *chir* earlier into and keep it longer in the tapping class. France and the United States of America with their short rotations—*P. maritima* 65 to 75 years; *P. caribaea* and *P. palustris* from 25 to 60 years—and entirely different conditions of silviculture and resin management, do not face tapping duration problems. Our mainstay and hope in this connection has long been Champion's Bulletin No. 51 already mentioned. This demonstrated that, starting with a tree 3½ feet bhg. over bark, with a continuous sequence of 4-inch channels separated by 4½-inch interspaces, a healthy dominant individual should accommodate six five-year faces —five original and a sixth or "incremental face" as I call it, by virtue of girth increment during the previous 25 years of tapping; and that the interspaces or bark bars between the old faces would then, each in turn, be able to accommodate another set of interspatial faces, due to:

	4½	inches—original interspace;
	1	inch—increment (share of 30 years' girth increment); and
	1½	inch—callus formation, excluding bark.
Total	7	inches of secondary interspace.

so that continuous light tapping would be ensured on even our smallest tapped trees for a period of 60 years; thereafter one would be forced to cut channels over the—by then—completely healed original faces. As the average tree of 3½ feet bhg. was calculated to be 55 years old, it would be 115 years or about rotation age before such a contingency arose.

33. More recent growth data for *chir* indicate that the average tree of 3½ feet bhg. will be much older, about 66 and 81 years for II and III quality respectively or well over half rotation age, before it is tapped: whereas normal girth increment for either quality is more

favourable than that allowed by Champion—both putting on about 20 inches during the first 30 years of tapping, an expansiveness calculated to allow for a 7th face, *i.e.* a second incremental face, before interspatial tapping need begin (see current Working Plan for West Almora Division, paragraph 261).* In short:

(1) **Primary** tapping:

—5 original (primary) plus 2 incremental faces= $7 \times 5 = 35$ years.

(2) **Interspatial** tapping:

—7 interspatial or secondary faces between the above= $7 \times 5 = 35$ years.

70

(3) **Callus** tapping (over the healed primary faces). . . ?

34. Theoretically, then, we appear to be in a comfortable position. From the moment we cut our first channel, a neat little race is on; between the progressive encirclement of the bole by our channel pattern, in $8\frac{1}{2}''$ jumps every five years, accentuated by *kurchan*, and the rate the stem can increase its girth and fill in the old faces with callus—with the channel-fluted stem just holding its own. Our average, minimum girth *chir*, in short, may be expected to begin yielding resin somewhere around 70 years of age and go on continuously till felled, about half a century later. Any larger tree brought under tapping would, of course, have room and to spare.

Thus theory. Why, then, the alarm and despondency I have commented on? Has it any basis in fact?

35. As soon as I joined West Almora I determined on a rough preliminary check of the tapping life of coupes, selected all over the division but with a special eye to those reputed to be nearing their end. During the preparations for this I garnered the following pertinent information:

(*i*) No such thing as a connected tapping history existed for any coupe or compartment; to me, a great and embarrassing want.

*These figures, however, ignore the considerable reducing effect of thorough *kurchan* and *per contra* any abnormal increment of the channelled bole, though the latter, at a mere 3/4 inch extra girth growth per decade (U. P. For. Bulletin No. 8) is no offset. And they may not be applicable to trees with considerable twisted fibre, such as form a high proportion of our resin capital.

(*ii*) No area has as yet actually been exhausted and abandoned except, of course, in the process of regeneration fellings.

(*iii*) Enumerations kept no tally of either new or abandoned trees, *i.e.* of gains and losses. They were confined simply to a flat count of the numbers of trees set up.

(*iv*) The carefully conducted, complete enumerations of the previous two years (referred to in paragraph 10 of part I) had startlingly revealed the true extent of losses by stripping coupes of their illicit gains in undersized tapped trees: or at least of some of them. Thousands of prematurely tapped stems that had meanwhile grown to tappable girth were kept on. "Baby snatching" is, of course, an old tapper's trick but it seems recently to have been intensified under the growing pinch of casualty.

(*v*) Trees were being abandoned as soon as they had no further room for primary channels. No one, not even the printed Tapping Instructions, had envisaged interspatial tapping—that lay, by all the Gods and Bulletins, in the lap of a still remote future.

36. This, I felt, was enough to start on. After the necessary field instruction selected members of the range staffs, including two young Rangers fresh from Dehra Dun and kindly lent me by the D.F.O., East Almora, were sent into the various coupes and with a specially banded 7 feet metallic tape planned future primary channels round every tapped bole according to current rules, booking each tree in a form finally elaborated to the following:

Serial No. of tree. (This was the number given at resin enumerations.)	B.H. Girth class Ft. In.	Number of years of tapping life, *i.e.* bole space left. 1	2	3	4	5	6	7	8	9	10	11 etc.	No. of channels already cut (including current channel).
Examples :—													
180	4-5	..	..	1	..	..	..	..	..	..	..	..	11
186	6-7	..	..	..	..	..	1	..	..	..	..	..	16

By summating the number of trees in each "tapping-life" class we got, *e.g.* in the actual case of Billori 18—

No. of trees examined ..	3 100												
Acreage ..	135	76	116	162	228	257	221	221	209	216	222	196	etc.

37. Now, assuming that the least concentration of channels a mate will take up for tapping is eight per acre (it is some figure near that—we should know soon enough now!) one can run from left to right along the totals and find the last year in which tapping will remain economic. Thus, in the example above, 1928 channels will have dropped out after 10 years, leaving 1,172 channels on these 135 acres = 8.7 per acre. The very next year, however, 196 more channels go, leaving about seven per acre or too few to attract tappers. The tapping life, in terms of primary channels, is thus about 11 more years.

It may be noted that—

(*a*) little allowance was necessary for the effect of girth increment, if only because of the limited tapping-life expectation from these coupes;

(*b*) any recruits to the tappable stock could safely be written off against losses from rights fellings and ordinary casualty. In this division these are generally heavy; and

(*c*) estimating future channels by specially prepared tapes can be done quickly and quite accurately wherever tapping space is limited: our concern was to fit in two or at most three faces. In the coupes examined much personal checking led me to think that the estimates were on the liberal side.

38. This rough and ready method with local variations that do not matter here, was applied in eight different areas scattered over four ranges, with a total of over 6,000 trees, all known to have been under light tapping from or before the war period and therefore representative of a very large proportion of our resin-yielding forest. Their tapping expectation at eight channels per acre was found to vary *from five to twelve years*. Despite certain crudities of the method and the limited samples of forest examined I do not think these figures will prove far out.

39. Now what was one to make of this? Let us look into the history and condition of these areas a little more closely. Only three of them, I discovered, had been tapped for the five-year spell of "intermittent" tapping (five years followed by 10 years' rest) that obtained up to the war period: several, it seemed from the field counts and patchy records, had missed anything from one to five years of tapping since. Against these, in the third column of the Table below, I have accordingly put, with query marks, the nearest

figures I could arrive at. They can be only a year or two out at most:

Area.	Year tapping begun.	No. of years tapped to end of 1937.	Tapping years left.	Total tapping life (primary cycle).
1. Billori 18	1920	16	11	**27**
2. ,, 19	,,	16	12	**28**
3. Sitlakhet 3, 13	1918	17	9	**26**
4. Siahidevi 15	,,	19	5	**24**
5. Chantharia 14	1912	21 ?	6	**27**
6. ,, 2, 15	,,	21 ?	7	**28**
7. Ganiadeoli 1	1905—9 and 1918 onwards	23 ?	7	**30**
8. Kaligadh 13	1917	21	12	**33**

Except for Nos. 7 and 8, the range of tapping life comes out remarkably close. Or perhaps one should not consider it remarkable seeing that these areas contain much the same irregular crops, untouched save for rights fellings, and carrying between 23 and 26 channels per acre. No. 7, with the longest tapping history, has had eight years' intermission, which has spun it out and compensated for low stocking (20 channels per acre): while No. 8, selected deliberately for comparison with the others, is altogether exceptional, being in an area free of all rights and consisting of an untouched, unusually well grown, regular and dense submature crop, averaging 40 channels per acre, a concentration seldom attained in this rights-ridden division. Definitely remarkable, however, is the fact that despite the often high proportion of large size trees (as much as 49 and 58 per cent. of the tappable stock in Nos. 1 and 5 exceed 5 feet bhg.), only one of these areas promises more than 30 years of tapping. Yet even the smallest stems initially tapped should not have completed their primary tapping cycle, much less any of their bigger brothers. What is letting us down? A tentative analysis of the past/future ratio of tapping life of all the $3\frac{1}{2}$ feet to 4 feet girth trees, some 1,600 of them, did not help much, these being discovered in all stages of tapping from the first to well over 20 years (!), the considerable number of the latter betraying past "baby-snatching" or else stagnancy due to suppression, but not helping to clarify the issue.

So much for a preliminary probe into the matter. Later, after much fossicking in old records, accompanied by field checks, I collected sufficient data to be able to approach this enquiry from a different angle and in a more precise and scientific way.

40. This consisted, essentially, of testing actual tapping progress against theory on trees tapped continuously for x years and deduced

from diameter-age curves to have been of the minimum bhg. ($3\frac{1}{2}$ feet) x years ago. Simple as it sounds, the method revealed an increasing number of snags and limitations in practice, and the more as one attempted to cast further back. Apart from quality and crown class of tree, allowance had to be made for the contrary effects of past *kurchan* and abnormal increment of the tapped portion of the bole: moreover, the older the tapping history of a coupe, the more had the selected class of tree suffered scorching and basal scarring or badly cut or conflicting channel systems—all factors disqualifying stems for appraisal. In a preliminary essay with the Silviculturist, two areas were examined:

(1) in Ranikhet Cantonment, with 17 years' completed tapping (4th face in its 3rd year), for trees of 47″—51″ bhg.;*

(2) in Chilianao block of the division, with 22 years' completed tapping (5th face in its 3rd year), for trees of 50″—54″ bhg. and the remaining tapping space estimated on all healthy dominants of the respective girth classes and tapping history. Although only 40 and 13 trees respectively were found, the results were instructive; the average primary cycle came to 25 years and only a fifth of the stems promised room for a sixth face, none whatever for a seventh.

41. This got us back to 1916, the year certain coupes first changed over from intermittent to continuous tapping. More recently, after further searching of records and the jungle, I found what I had long been looking for—two areas that had switched over from intermittent to continuous tapping *without a break*, had been tapped every year since and so offered trees that had been under the adze for twenty-five years or more and therefore *beginning the all-important 6th face.*

Here at last was material for a full-dress investigation, embracing both the primary and interspatial cycles of tapping—stems of the critical size demonstrating, in mid-course, the practical working out of Bulletin theory. Both areas were favourable, having a fortunate fire history and well conducted channelling; site II—III quality, of average gradient and stocking, and typically irregular. In short, a very fair sample of the sort of forest we tap.

42. There was no real need, here, to take a "bracket," only an upper limit, as stems bearing over a quarter century of channels and tapped in reasonable conformity with the espacement rules had necessarily to have reached a certain size class: on anything smaller,

*In 17 years, normal II—III quality trees of 3½ feet bhg., should grow 10-11″, making a total of 52—3″ bhg. With *kurchan*, here, both moderate and recent a 2″ reduction should suffice, giving an average tree taping about 51″. The "bracket" of 4″ was designed to catch the more slowly growing stems and include all relevant variations worth study.

tapping would already have been abandoned. With *kurchan* more than offsetting any abnormal increment of the tapped bole, I searched out stems up to 60 inches bhg., neglecting only the suppressed and those with badly scorched, crookedly cut or conflicting faces, and booked them as per actual sample below:

Ganiadeoli Compartment 3. Intermediate P.B. of the Chir Commercial Circle. 26th Year of Continuous Light Tapping.

Serial No. of tree.	Bhg. and crown class.	No. of faces and years tapped (completed).	Whether tapped in 1938.	Minimum breadth of interspaces including callus* (in descending order).	Further 6th face tapping possible.	Remarks.
1	2	3	4	5	6	7
1	58″-9″ D	5×(5) =25 yrs.	No. abandoned	1—11″ —15 yrs. 2—10″ interspa- 3—10″ tial tapping. 4—5½″ ? 5—3″	No.	No scorching.
14	55″-6″ d to D (now)	1×(6) 3×(5) 1×(4) =25 yrs.	do.	1—10″—5 yrs. 2—6¼″ ? interspa- 3—6″ tial tapping. 4—4¾″ 5—4¾″	No.	Moderate scorching.
36	52″-3″ d	5×(5) =25 yrs.	do.	1—7½″—10 yrs. 2—7″ 3—5″ ? 4—4″ 5—4″	No.	2 faces slightly scorched.
39	59″—60″ D	5×(5) =25 yrs.	**Yes; 1st year of the 6th face.**	1—10″—10 yrs. 2—7″ 3—6″ ? 4—5½″ 5=13″, now being 6 cut.	**Yes: 4 more years.**	1 face slightly scorched.

Representative examples have been given. In column 3, of course, all faces add up to 25 years. In column 5, the interspaces marked by queries were rejected in the count of continuous tapping life, on considerations referred to later. Note that trees 1 and 36, and (though less blatantly) 14 also, bear one or more faces cut too close together: and that No. 39, in heavy type, can accommodate a full 6th or incremental face—what we call a "sixth-facer" tree.

43. This compartment and one other, Karchuli 1, in its 27th year of continuous tapping, offered a total of 109 acceptable stems ranging from 50 inches up to 60 inches bhg., which I classified as follows:

*Cuts and other adventitious wounds were ignored. The channelling being regular, the maximum and minimum breadths varied within small limits.

No. of years tapping left (in 5-year classes).	Breast-height Girth (over bark) in inch classes.										Total trees in each tapping life class.
	50″-1″	51″-2″	52″-3″	53″-4″	54″-5″	55″-6″	56″-7″	57″-8″	58″-9″	59″-60″	
D (84 trees) 25 ..	..	..	..	..	1	..	2	4	**2(5+20)** 3	**5(5+20)** 5	22
20 ..	..	2	..	**1(5+15)** 2	..	1	**3(5+15)** 7	**1(5+15)** 2	**2(5+15)** 4	**3(5+15)**	28
15 ..	..	1	2	2	2	3	**1(5+10)** 4	2	**1(5+10)** 2	**1(5+10)** 1	22
10 ..	2	..	..	..	4	2	..	1	..	**1(5+5)**	10
5 ..	..	..	1	..	..	..	..	..	..	..	1
None ..	..	1	..	..	..	..	..	..	..	..	1
d (25 trees) 25 ..	..	..	..	..	..	..	..	..	1	..	1
20 ..	..	..	..	1	3	..	..	1	..	..	5
15 ..	1	..	..	..	2	..	2	1	..	**1(5+10)**	7
10 ..	..	1	1	..	..	1	..	1	..	..	4
5 ..	..	1	1	..	1	2	1	..	..	..	6
None ..	1	..	..	1	..	..	..	..	..	..	2
Total trees in each inch class ..	4	6	5	7	13	9	20	13	15	17	109(84**D**: 25**d**)

I give the complete data because they are so instructive and one only wishes that more material had been available. Entries in heavy type followed by figures in brackets denote trees having incremental (6th face) as well as interspatial tapping left; those without have interspatial only. Thus, along the 25-year line, three dominant trees of the 58—9 inches class have 25 years of interspatial tapping left and two have five years incremental tapping followed by 20 years interspatial. It will be seen that—

(1) only 22 trees or 20 per cent. can accommodate a whole 6th face; all save one being dominants.

(2) 16 of these exceed 58 inches bhg. and must, therefore, have been rather above minimum size (42 inches) when first tapped in 1912-13 or else have grown exceptionally fast. This leaves a mere 5 per cent. that started fairly from scratch.

(3) only a fifth of the trees, and these, of course, the larger dominants, promise 25 years' more tapping or a total tapping continuity of 50 years: the majority have only 15 or twenty years more.

I should also add, from the full field data:

(4) Some 75 per cent. of the trees capable of taking a 6th face have one or more faces cut much too close; so, indeed, have at least 60 per cent. of all the trees. *Per contra* most trees bear one or more faces cut too far apart. Such asymmetry we cannot afford, only losing on the secondary swings what was gained on the primary round-abouts or *vice versa*.

44. Finally, making a very long cast—the longest, I believe, now possible in this division—I searched the same area this autumn for stems up to 65″ bhg. bearing at least six full faces, with the following prolonged tapping history:

1905—09—five years' tapping;
1910—12—three years' rest;
1913—38—26 years' tapping;

this 65 inches, plus a modest allowance of 3-4 inches for *kurchan*, being calculated to catch even fast-growing stems of 3 feet 9 inches tapped for 31 years. In all this area of 180 acres, only 16 stems had qualified up to 1937, three of them had lasted out 1938 by sporting a spurious 7th face (31st channel) and all had "cheated" to the extent of one or more close-set faces. At the same time, fires during the earlier part of their tapping life had seriously retarded callus formation and shortened the interspatial cycle to a mere 10—15 years.

ASSESSMENT OF LOSS OF TAPPING LIFE

Serial No. and girth class of tree.	FAULTS IN CHANNELLING.								DEFECTS IN THE TREE.									DEFECTS IN SITUATION.	
	LESS THAN 5 YEARS OF FACE CUT BECAUSE			CHANNELS CUT TOO BROAD. (> 4″)		EXCESSIVE INTERSPACES. (> 4½″)			NATURAL (IN GROWTH).				ARTIFICIAL OR ACCIDENTAL (TO GROWTH).						
									Overhang.					*Channels burnt.*					
	Too much cut per year.	Basal channel started too high.	Tapper neglected to cut topmost channel (s).	One face.	More faces. (includes lateral extension of channels by trimming, wounding, etc.)	One.	More.	Bad, *i.e.* wasteful alignment (includes conflicting systems).	Straight bole but leans.	Misshapen bole (includes forking).	Knots, branches, burrs, etc.	Suppression (little or no increment).	Basal fire scar.	Healing retarded.	Healing prevented altogether.	Interspace encroached upon (charred).	Other wounds (*e.g.* felling injury, theft of *chilka**).	Excessive gradient.	Inaccessibility due to proximity of other trees, rock outcrops, etc.
1	2·1	2·2	2·3	3·1	3·2	4·1	4·2	5	6·1	6·2	7	8	9	10·1	10·2	10·3	11	12	13

*Torchwood scooped out of the living tree.

45. These results strikingly confirm the tentative findings in Ranikhet Cantonment and Chilianao. Derived as they are from the very pick of the channelled trees, they indicate what a wreck practice can make of theory. If to faulty spacing we add the more wanton waste of vagrant or conflicting channel systems—such as I illustrated in Part I—to say nothing of the frequency of stagnant growth found in this class of tree, we seem justified in the following conclusions:

That the smallest tapped stems in our forests, say from 3 feet 6 inches to 4 feet bhg., cannot be expected in any numbers to bear a 6th or incremental face—much less a 7th—under the treatment they have received up till now; and that if, on this account, interspatial tapping is embarked on 5 to 10 years prematurely, their tale of continuous tapping life will dwindle from 70 to something less than 50 years.

46. Here, I think, we get a clue to our trouble. While it is true—and lucky for us—that we did not start tapping in a forest full of minimum size trees, the many factors making for waste have been ceaselessly operative on every girth class and encroached far more than we realise on our bole-space capital. Champion in his Bulletin attempted a quantitative study of loss on over 1,500 stems, discovering only 14 per cent. (of total tapping years) contributed as follows:

By wrong spacing (including bad alignment) ...	9.1 per cent.
By wounds	3.1 per cent.
By bad ground	1.7 per cent.

That was in 1919-20, when the system of light continuous tapping had hardly got under way. The warning then sounded has been more than justified by events. We have run that system now for nearly quarter of a century and with the channels before us in the forest, could, I feel certain, revise at least the first two figures very substantially upwards: to say nothing of supplementing the items. I give my own field form—

A worth-while quantitative analysis would have to be based on many thousands of trees and I have myself had time only for the far simpler counts of *frequency* of defect, on a number of tapped-out stems, which show col. 4, excessive interspace, to be commonest (77 per cent. of trees examined) with cols. 5 (bad alignment) and 2.3 (neglecting to cut the topmost channel) fairly close runners-up. Such figures, however, are not of themselves of much value since loss depends on magnitude as well as frequency, and heads like 6.1 and 12 have comparatively less frequency but are each highly potent for loss. Here is the wherewithal for an interesting, if melancholy investigation, one that would give quantitative expression to past casualty and our present fears. In its stead, harking back from causes to effects, I think I can present the petering-out process in an equally convincing way. An analysis of Billori Ct. 18, an area where my investigations of total tapping life were both more extensive and more detailed than elsewhere, throws an interesting sidelight on the incidence of exhaustion and lends support to my findings thus far.

47. Look, if you please, at the table on the next page—it will be the last, I promise you. This Billori 18, an Intermediate compartment of the Resin Working Circle, was under tapping from 1920 to 1937 with a two-year break, *i.e.* it has had 16 years of actual channelling: and its crop of 3,100 trees affords an excellent sample of the irregular, often twisted and crooked stuff we extract our resin from. I have classified them by girth classes, with the remaining tapping years running in an ascending sequence across the page, the zero column, of course, showing trees whose last tapping season was 1937:

INCIDENCE OF TAPPING EXHAUSTION BY SIZE CLASSES: BILLORI 18.

Girth class in feet.	Number of Years of Tapping left after 1937.																		Total trees in each girth class.
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17 etc.	
	showing the number of trees lost after each year.																		
3½′—4′ ..	2	13	20 *17%*	21 *13%*	43 *19%*	36 *14%*	36 *16%*	28 *13%*	34 *16%*	50 *23%*	61 *27%*	68 *35%*	51 *29%*	37 *23%*	26 *26%*	44	33	17	648 *21%*
4′—5′ ..	7 *50%* **·7%**	23 *37%* **3%**	37 *32%* **7%**	67 *41%* **14%**	94 *41%* **24%**	117 *46%* **37%**	88 *40%* **46%**	98 *44%* **57%**	86 *41%* **66%**	61 *28%* **72%**	53 *24%* **78%**	40 *21%* **82%**	34 *19%* **86%**	45 *28%* **91%**	18 *18%* **93%**	24 **95%**	19	8	937 *30%*
5′—6′ ..	2	13	39 *34%*	38 *23%*	41 *18%*	56 *22%*	52 *24%*	50 *23%*	49 *23%*	60 *28%*	61 *27%*	56 *29%*	50 *28%*	45 *28%*	27 *27%*	28	13	12	703 *23%*
6′—7′ ..	3	9	13	18	28	31	29	28	26	33	36	20	31	25	21	28	27	23	513 *17%*
7′—8′ ..	..	3	7	14	17	11	10	14	13	10	8	8	10	9	7	7	4	9	240 *8%*
8′—9′ ..	..	1	..	4	3	4	6	2	1	2	2	3	..	1	1	..	..	2	49
9′ and up ..	..	..	..	..	2	2	..	1	..	..	1	1	..	1	1	..	..	..	10
Total loss per year ..	14	62	116	162	228	257	221	221	209	216	222	196	179	163	101	131	96	71	3100

For the sake of space I have omitted years above 17—they are unimportant, though interesting, including a few die-hard stragglers of the lower girth classes and some dozens of the better favoured stems above six and seven feet. But I have given the total trees in each girth class as well as the percentage this forms of the total tapping stock. Below the number of trees falling in certain tapping-life classes appear other percentage figures, and in the case of the 4—5 feet girth trees, two sets. The first set, or row, in italics, shows what proportion of the year's casualty is composed of that girth class; thus, in the first vertical column, the 7 trees of 4—5 feet girth lost to the 1938 tapping season comprise 50 per cent. of that year's losses (*viz.* 14), the 23 that follow them in 1939 are 37 per cent. (of 62) and so on. The second row of percentages in heavy type, along the 4—5 feet line only, are *cumulative* figures, rounded to the nearest whole digit and show how much of that girth class has dropped out to date. First of all, note that the 4—5 feet class bulks largest in the tapping stock, if only because the $3\frac{1}{2}$—4 feet trees form a mere six-inch class, not a whole foot: and that the upper girth classes are abnormally represented, a characteristic of our forests already emphasised. Next, from the first set of percentages, how heavily and consistently the 4—5 feet class contributes to each year's casualty list. The highest percentage of each year is underlined. Except in the second year (1939) when the 5—6 feet class just heads it by 2 per cent., *it tops the list of defections for nine solid years,* by which time, as the second row of percentages shows, over 72 per cent. of the class have fallen out, leaving the girth classes on either side to take over precedence. Now, without labouring these figures, which the year by year translation due to increment and casualty must continually modify, I think they tell us something of importance: something we seem to have discovered before. For the present 4—5 feet class that is due to peter out so heavily during the next decade *includes all the trees that were of the minimum tappable size in* 1920 when channelling started. Once again we find this class failing us. After about 20 years of tapping they just "can't take it"—and it is essentially their default that brings the whole compartment to an end during that same period (see para. 37). I say "essentially" because defections in the circumjacent girth classes do contribute surprisingly heavily in the last 6 or 7 years of this compartment's tapping life; even before the second decade of tapping

is done the casualty list in this type of forest seems to become a composite one, with every size class adding its variable quota from year to year. In the example before us, indeed, over 40 per cent. of the casualties in the eleven years run that is left, derive from trees above 5 feet girth; the Old Boys are feeling the pace too!

48. So much for quantitative data. I do not pretend that these small field studies of mine, undertaken in the midst of a busy working season, are either complete or conclusive: but to one who spends most of the year in resin-tapped forest confronted daily by thousands of channelled boles in all their variety of size, shape, condition and progress of channel-pattern, they help build up a picture. A picture of poorly tended, generally ill-stocked, irregular forest in which all the multitudinous factors for bole-space loss are operating in all their varied potency—the smaller trees, often long suppressed beneath their elders or prematurely tapped, now petering out on their primary tapping cycle, handicapped in a hopeless race; the larger still lasting out against misalignment and bad cutting but the biggest of them, the now overmature stagnating stock, often bearing a legacy of crude multiple channelling* that has substantially depleted their tapping capital. And the picture cannot be considered complete, I think, without mention of the following:

(*a*) the high proportion in our more accessible, village-ridden forests of trees of the "depressed classes"—not merely dominated and suppressed, and therefore incrementing slowly, but crooked, fantastically twisted, leaning, knotty or otherwise crippled and defective individuals. As these are not the trees removed in right fellings or petty sales, the tendency has been for this unfortunate class, with its low tapping potentiality, to form an ever larger proportion of our resin crop.

(*b*) the increasing degrade especially in our new Reserves of *site quality,* from the evil combination of regular burning with incessant browsing and over-grazing in hilly, often steep, country. Annual or biennial burning of resin areas is forced on us as a measure of fire insurance; the hordes of lean, ribby cattle and voracious sheep and

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*Before 1916, two channels on 4½—6 feet g., and three on larger trees, a regime natural under the Selection system: after 1916, two channels on trees 7 feet g. and up. Ten years of double tapping reduces a 7-foot tree to the bole space of one 5½-foot girth.

goats are there by right or popular clamour. Their combined and cumulative influence in desiccating and depauperating, even to erosion, the forest soil that should nourish our trees, is surely being reflected in the growth, shape and health of our growing stock, not least the badly needed recruits to our tapping capital.

49. And finally there is fire, *i.e.* direct fire damage to the tree, which I mention last because its menace, if perpetual and universal, confounding all our calculations, bears chiefly on the interspátial tapping cycle we are being forced prematurely to contemplate—in terms of scorched and ruined callus, or even charred and drying interspaces. With Kumaon's unfortunate incendiary history, the proportion of these had mounted distressingly high before the introduction of controlled burning during the present decade compounded this arson at a reasonable figure.

(*To be concluded.*)

GERMINATION OF NIM SEED (AZADIRACHTA INDICA)

By M. V. Laurie, Silviculturist, F.R.I.

Readers may recollect that in the August number of the *Indian Forester* a letter to the Honorary Editor on the above subject was published. The main point raised was that while many people find *nim* seed difficult and irregular in germination, in one range in Madura district, Madras, excellent and regular results were obtained from *nim* seed collected, not from *nim* trees, but under *Ficus* trees where they had been dropped by birds. Such seeds were found to be pure white in colour, as compared with the ordinary brownish colour of the seed collected from *nim* trees and removed from its skin.

Since then a number of forest officers have written to say that they have no difficulty whatever in getting good germination. Allowing, however, for the one or two that wrote to say that they did have some difficulty and for the fact that people do not normally write to the papers about things they *can't* do, it was considered that there still was sufficient doubt about the regularity of germination to make it worth while getting to the bottom of it.

Accordingly, the Research Ranger at the F.R.I. borrowed a few hens from an obliging shopkeeper, and offered them temptingly ripe *nim* fruits to eat. They turned up their beaks in scorn. The birds were then put on starvation rations for a day or two, and when ravenously hungry were again offered the *nim* fruits. They looked at them hopefully, but suspiciously, and finally decided that a hunger-strike was preferable to such a revolting diet. Finally, by moistening the fruits and rolling them in flour so as to camouflage them, the long suffering birds were persuaded to eat them. They swallowed them whole. When a sufficient number of seeds had been devoured, the birds were given a good meal and the reappearance of the seeds was anxiously awaited. Days passed by without a sign, and it was finally decided that they had been digested, so the hens were returned to their owner, none the worse for their experience.

Since the hens were so unobliging, it was not possible to include in the comparative germination experiments seed that had been cleaned by birds in the same way in which the seed which had been picked up under *Ficus* trees had been naturally cleaned. Artificial cleaning was, however, tried to see whether, as in so many drupaceous fruits, removal of the pulp improves germination. Three treatments were compared, namely—

A.—Control—fruits uncleaned, and skin left intact.

B.—Fruits skinned but pulp not removed. (Seeds were a brown colour after drying.)

C.—Fruits skinned and pulp thoroughly washed off. (Cleaned seeds were white in colour.)

Treatments B and C were done 24 hours before sowing, and the seeds were air-dried under shade in all cases.

Sowings were done on the 24th July 1938, 400 seeds of each treatment being sown in eight replicated sets of 50 of each kind. The beds were not watered or shaded, and monsoon conditions prevailed.

Germination started in four days for C and nine days for A and B, and in all three cases was practically completed by the 35th day after sowing.

The plant percentage by the end of August 1938 was:

A.—Control	...	...	13 per cent.
B.—Roughly cleaned	...	...	42 per cent.
C.—Fully cleaned	...	...	63 per cent.

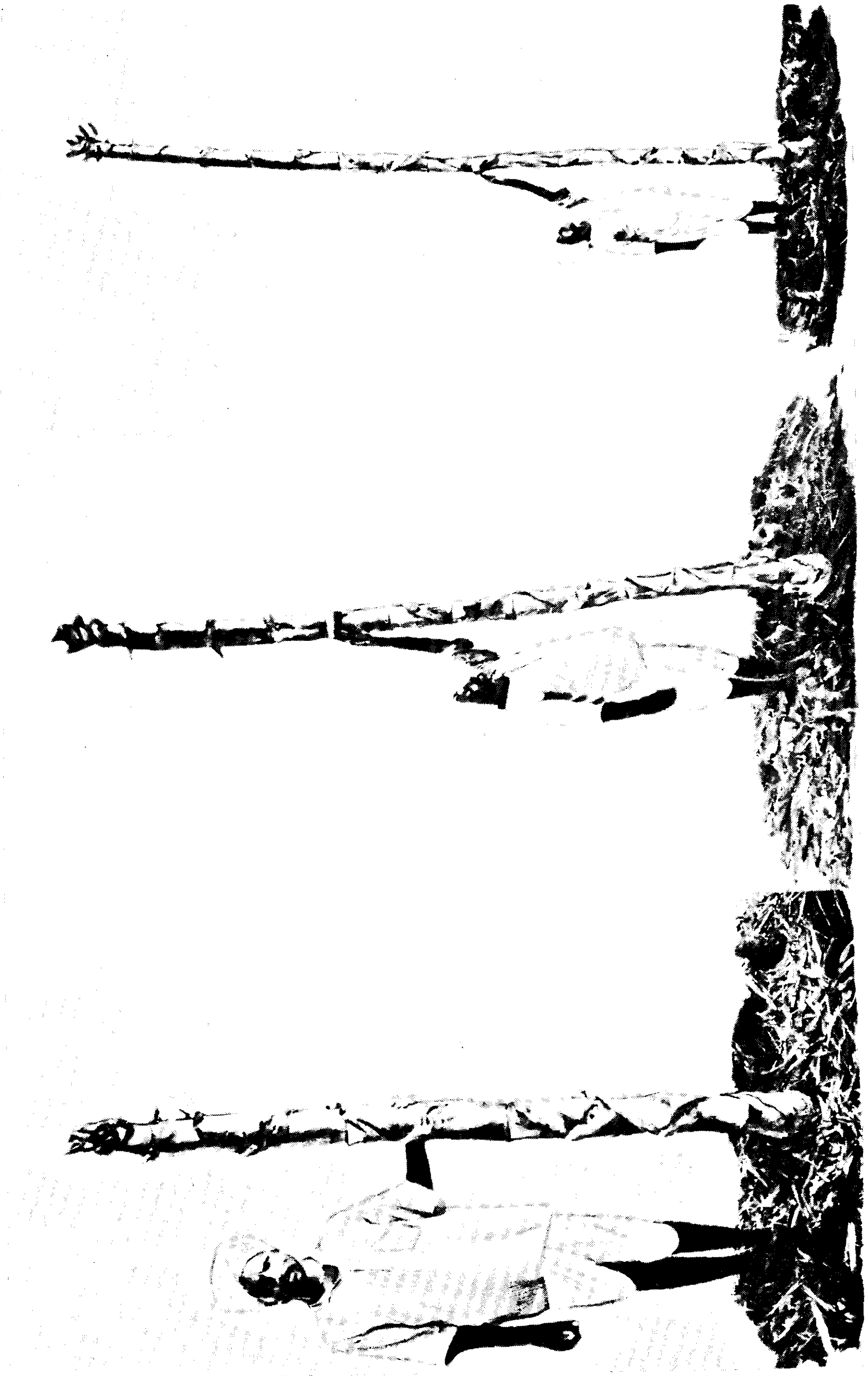
—the differences being all highly significance, (χ^2 test). Mean heights varied from 3.5 inches to 3.9 inches by the middle of November for the different treatments but did not show significant differences.

The conclusion is, therefore, that thorough removal of the skin and pulp by washing so as to give a clean, white seed causes a great improvement in germinative capacity (almost five times as good as uncleaned seed in this experiment), whereas intermediate results are obtained with roughly cleaned seed. It appears, therefore, that thorough cleaning of the seed is definitely worth while.

Elsewhere in this number is published a letter from Mr. N. D. Sahni, District Forest Officer, Nellore, on this same subject. While the evidence of the above experiment indicates that his disbelief in the benefits of depulping is probably incorrect, his experiences regarding other factors influencing germination and early growth, and especially the advantages of a burn over the soil before sowing are important, and have been corroborated by research work done by the Madras Provincial Silviculturist which demonstrated the very marked advantages of burning when attempting to regenerate dry forests. It is interesting to hear that, in Nellore, this species stands considerable damage from nibbling by cattle, deer and *sambhar*, as this has definitely not been the case in the *taungyas* in parts of the United Provinces (Saharanpur division), where lines of *nim* were almost completely wiped out by browsing. It may, of course, be a matter of difference in intensity of browsing, but it would be interesting to hear other experiences in this matter, and also whether they share Mr. Sahni's happy experience of finding that *nim* seedlings do not die back in the hot weather following the first monsoon.

GROWTH OF BAMBOO SHOOTS

The rapid growth of bamboo shoots is well known. Agnes Arber[1] chronicles a number of recorded measurements in terms of growth per day in various species of the bamboo and from different



6′ 4″
31st August 1938

11′ 4″
7th September, 1938

23′ 1″
14th September 1938

The bamboo shoot above has been growing so rapidly as to dwarf the person standing alongside of it to one third of its height in the course of two weeks.

parts of the world. This includes a record of a little over 3 feet per day for *Bambusa arundinacea* Willd. (at Kew), 2 feet 9 inches for *Phyllostachys mitis* Riv. (in Japan) and 2 feet 6 inches for the Chinese bamboo "Mow-chok."

One chief inducement for attempting the cross between sugarcane and bamboo[2] at Coimbatore was this observed rapid growth of shoots in the *Bambusa arundinacea* avenue on one of its borders. The picture reproduced here is an attempt to record this rapid growth by means of weekly photographs. The comparatively dry and open conditions prevailing at Coimbatore are not very conducive to rapid growth of bamboo shoots; but, even so, growth of as much as 1 foot 8 inches per day of 24 hours, was re corded during the second week in the series of photographs taken. The new shoots for the year appear at Coimbatore about July-August and these rapidly grow to a total height of over 40 feet in about a month, after which the growth phase manifests itself in the profuse development of secondary and tertiary branches.

T. S. VENKATRAMAN,

Imperial Agricultural Research Institute,

Coimbatore Sugarcane Station, Lawley Road Post.

REFERENCES

1. Agnes Arber: *The Gramineae,* 1934, page 62.
2. Venkatraman, T. S.: "Sugarcane—Bamboo hybrids." Indian Jour. Agric. Sci., 1937, VII, Pt. III, page 513.

FOREST HUMOURS

It is a long time since the editorial appeal was made under this head in the *Indian Forester,* and feeling that such an appeal could not possibly go unheeded, I have anxiously searched every copy for more than two years for further "humours." Alas, my searches have been in vain. Possibly the Editor is storing up the replies and will in due course issue a special "Humours Christmas Number." For forest pleasantries and jungle jests must be the lot of all of us, and rich must be the store of humour if only it be garnered.

With a twinge of conscience at my prolonged delay, I venture to add my mite, in the hope that it may still be considered worthy to find a place in this inestimable periodical.

Firstly, a racy idiom that our American cousins could hardly better. A keen Range Officer, who had discovered a somewhat dead wild elephant in the jungle, came to inform me in the following terms: "Sir, there is a pair of tusks defuncting in backside of plantation, compartment 3." The more orthodox "deceasing," one feels, would have been a poor substitution—more especially down-wind.

Then there was a waggish resin muharrir, whose English quips and *bon mots* still stick in my memory. On one occasion, he innocently enquired of my Conservator (whose footsteps he had been dogging for an hour, as if there were something important on his mind), what he thought was the most jollisome sight in the jungle? The Conservator, without doubt fatigued by an arduous inspection, could not give the matter the consideration it clearly deserved, and at once shrugged his shoulders and gave up. "Three chirs,* Sahib," said the muharrir, with a meek twinkle. And we moved off uttering hearty laughs.

It was in this same division that a Forester adroitly posed me the following, facsimilating a serious scientific air:

"Where does a *chir* pine go to when it is tapped-to-death?" His succinct reply, "To blazes," shows that one can tap humour from a mind running in many channels—perhaps even a pun from a Pandit!

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* *Pinus longifolia* (Roxb.)

[*Perhaps the following advertisement, which appeared on the editorial breakfast table one Monday morning, may appeal to our contributor. The spelling and contents are precisely as printed in the original.*—EDITOR.]

AN A GRAPE FRUIT A DAY
KEEP DOCTOR AWAY.

A Good Health................................

...........................Better Than Welth

"Grape Fruits" the World Famous Effervescent Health Bulder Grape fruits has quencher which can be drink with benefit at before

breakfast, established a reputation unque in the history of human, corpulency: —

The treatment of this trouble some condition welfare is greatly helped by the regular use of Grape Fruit this will ensure inner cleanliness and thus aesist such other measures for the reduction of superfluous fat as may be adopted.

Digestive ailments.	Splun.
Disorders of the liver.	Dysentry.
Bed Complestion and Disorder of the Blood.	Vomit.
Reheumatic Conditions.	Bellyache.
Sleeplessness.	Hiecup.
Pregnancy in the morning sickness Heart-burn.	Paipitation.
Headache.	Indigestion.
Cholera.	Epistaslis.

Directions for Use.

Cut a Grape fruit into two parts take juice out of a part in a glass and Mixed a table spoon of sugar take first thing in the morning before breakfast.

Grape fruits are recommanded by many doctors all over the Erope and all other contirys more ever better for Brain workers.

Taste of the Grape fruits are like sweet sour and simple bitter.

Selling Agents: —

X X X, Contractors,
For Married Families and
Military Officers Lines.

SUMMARY OF REVENUE, EXPENDITURE AND SURPLUS OF THE FOREST

Heads.	Imperial.	Bengal.	United Provinces.	Punjab.	Bihar.	Orissa.	Assam.
Revenue—							
Timber and other Produce—							
1936-37 ..	..	18,35,757	44,36,143	22,46,434	5,64,747	4,28,300	16,85,140
1937-38 ..	..	21,54,330	50,02,500	23,60,192	7,00,926	4,29,086	17,50,720
Expenditure—							
Conservancy, Maintenance and Regeneration—							
1936-37 ..	..	5,32,572	9,96,713	13,14,797	1,21 835	1,12,964	2,77,643
1937-38 ..	..	5,94,716	9,83,635	11,22,409	1,69,268	99,621	3,30,780
Establishment—							
1936-37 ..	54,399	8,76,158	18,79,145	10,75,179	3,71,363	3,24,991	9,15,243
1937-38 ..	53,667	9,69,053	18,39,087	11,27,832	3,99,875	3,32,371	8,41,469
Total of Expenditure—							
1936-37 ..	54,399	14,08,730	28,75,858	23,89,976	4,93,198	4,37 955	11,92,886
1937-38 ..	53,667	15,63,769	28,22,722	22,50,241	5,69,143	4,31,992	11,72,249
Surplus or Deficit (minus)—							
1936-37 ..	−54,399	4,27,027	15,60,285	-1, −43,542	71,549	−9,655	4,92,254
1937-38 ..	−53,667	5,90,561	21,79,778	1,09,951	1,31,783	−2,906	5 78 471

DEPARTMENT IN INDIA FOR THE FINANCIAL YEARS 1936-37 AND 1937-38

Central Provinces and Berar.	Coorg.	North-West Frontier Province.	Ajmer.	Baluchistan.	Andamans.	F.C.R.I. and College.	Madras.	Bombay.	Sind.
47,63,565	3,49,637	4,35,636	85,780	38,729	13,16,471	36,684	46,35,742	47,71,684	7,28,282
50,50,094	4,04,546	5,12,122	83,795	1,17,761	12,88,947	1,08,921	48,57,341	43,15,039	8,29,835
14,20,134	1,00,173	1,07,395	30,956	..	7,63,391	64,134	..	..	..
14,62,927	88,100	1,72,667	30,589	..	9,05,131	71,066	..	..	..
20,38,127	1,11,223	1,99,011	33,792	..	1,81,460	5,55,140	..	..	..
20,57,655	1,15,211	2,17,933	34,148	..	1,68,984	5,73,347	..	..	..
34,58,261	2,11,396	3,06,406	64,748	36,180	9,44,851	6,19,274	40,49,121	28,07,104	3,35,182
35,20,582	2,03,311	3,90,600	64,737	97,407	10,74,115	6,44,393	40,95,373	27,26,418	3,52,887
13,05,304	1,38,241	1,29,230	21,032	2,548	3,71,620	−5,82,590	5,86,621	19,64,580	3,93,100
15,29,512	2,01,235	1,21,522	19,058	20,354	2,41,832	−5,35,472	7,61,968	15 88,621	4,76,948

TIMBER PRICE LIST, DECEMBER 1938-JANUARY 1939.
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 48-0-0 to 84-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-15-7 to 1-3-3 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 1-0-0 per c.ft
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-8-0 per piece.
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 4-13-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-12-0 per piece.
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 3-15-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
,, ..	,, ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 1-3-0 per c.ft.
,, ..	,, ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-13-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-3-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. Sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 52-0-0 to 90-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 0-14-0 to 1-2-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-12-0 to 1-4-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-9-0 to 2-6-10 per c.ft.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. Sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 1-4-7 to 1-6-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-14-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 2-6-9 to 6-1-3 per c.ft. in round.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-4-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-3 to 5-4-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 0-15-8 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 33-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-12-10 to 1-6-0 per c.ft. in round.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 0-14-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-4-3 to 2-1-11 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 2-3-3 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-14-0 to 2-13-6 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

REVIEWS

FORESTRY AND STATE CONTROL

BY PROFESSOR R. S. TROUP

(Published by Oxford University Press.)

At a time when Governments all over the world are paying increased attention to forestry and the evil results of forest destruction, and in some cases are increasing State control over private forests and waste lands, this little book by Professor Troup comes very opportunely. The dominant impression one receives by a perusal of this book is that State control of some sort seems essential for scientific and economic forestry, to produce the maximum sustained annual yield, and to develop the maximum productivity of the land fit and available for timber production. An interesting table shows the percentage of total land area under forest, and the classification of the forest area according to ownership, for 23 European countries. This table shows that Britain has the smallest percentage of area under forest, *i.e.,* 5.6 per cent. (which is even less than the United Provinces) compared to 44 per cent. in Russia, 55 per cent. in Sweden, and 73 per cent. in Finland. Of this small total, Britain has the largest proportion, *i.e.,* 86 per cent., privately-owned, and thus appreciably less than 1 per cent. of the area of Britain is under State or Corporation forests. A further interesting comparison is shown. Britain, which has the smallest percentage of total area under state forest, and the highest percentage of forest area under private ownership, also has practically no state control over private

forests, the productivity of which (per acre) is extremely low, probably the lowest in Europe, and forestry is one of the most backward industries in the country. Let us complete the picture by noting that 95 per cent. of Britain's timber requirements (mostly soft-woods) are met from foreign countries, that there is a serious shortage of timber (chiefly soft-woods) anticipated in less than 30 years, because the world's consumption exceeds the production by the astronomical figure of 17 thousand million cubic feet *per annum*, and that of Britain's total of three million acres of woodland, nearly one-third is felled woods and scrub, which is idle land producing nothing of value! (Except presumably foxes and pheasants.)

In Britain there is nothing except the law of entail to prevent an owner from clearing his woods without any attempt at regeneration, leaving behind devastated areas which are of no value to himself, his successors, or the country in general. Nor has an owner any obligation to manage his woods properly; in consequence the majority of British woodlands present a sad picture of neglect, while sustained yield management is seldom understood, much less practised.

Such a condition of affairs finds no place in a totalitarian State. In Germany, for example, in all private forests, the area that may be felled, the age of felling, even the intensity of thinnings, is strictly controlled; felled areas must be re-afforested within two years; there is even a law preventing the use of seed from badly formed or diseased trees and the elimination of such trees. But state control over private forests exists to a greater or less extent in all other European countries except Britain.

It is gratifying, however, to note that one million acres (or one-third of the total area of British woodland) is now under the control of the Forestry Commissioners, part being Crown woods, part unfit for tree growth, and part (over 350,000 acres) already planted up. This little book gives a convincing case to justify the Forestry Act of 1919, and the forest policy in Britain that was then started.

Professor Troup refers briefly to India, and points out that Chapter V of the Indian Forest Act gives all provincial Governments wide powers of control over all private forests *and waste lands*. It must be admitted, however, that hitherto these powers have not been extensively utilised, even where destruction of vegetation has

caused or is causing obvious erosion and desiccation. But one or two provinces at least are now beginning to take action or are exploring possibilities. But for India (including Burma) there is at least this justification of past neglect of privately-owned lands, that 25 per cent. of the total area of the sub-continent is State forest under the control and management of the Forest Department, a proportion which is higher than any European country except Finland and (presumably) Russia. But in Britain there is certainly no such justification, with less than 1 per cent. of the total area under State control.

E. A. S.

THE WOOD STRUCTURE OF SOME AUSTRALIAN CUNONIACEAE WITH METHODS FOR THEIR IDENTIFICATION

BY H. E. DADSWELL AND A. M. ECKERSLEY.

This small bulletin is a slight departure from the earlier publications on wood structure that have been issued by the Council for Scientific and Industrial Research in Australia. The authors deal with eleven different species belonging to seven genera of the family *Cunoniaceae*. All of them are timbers of commercial value on account of the ease with which they can be handled both for turnery and for joinery works. None of these species is represented in India, but still this publication is of considerable interest because of the conclusions that the authors have arrived at. Based on the anatomy, the authors have been led to divide these timbers into two main groups. The characteristics that have been used for this classification are all microscopic. The type and the shape of pits and their size have been used with advantage for this purpose. Another interesting conclusion that has been drawn is that the Australian species *Weinmannia lachnocarpa* can be better classified as *Geissois lachnocarpa*. On the whole it is an interesting publication and adds considerably to existing knowledge of the anatomy of timbers of the family *Cunoniaceae*.

K. A. CHOWDHURY.

EXTRACTS

SCOTTISH FORESTRY

"A brighter future for forestry was forecast by speakers at the annual dinner of the Edinburgh University Forestry Society, held in the Royal British Hotel, Princes Street, last night, under the chairmanship of Mr. L. M. Middleton.

Sir Thomas Holland, K.C.S.I., K.C.I.E., who proposed the toast of "Forestry," said that he knew of no industry that required from a man the same degree of conscientious regard for the future of his industry as was needed in forestry. The forestry officer never saw the results of good work. He would never hear what was said of

him—(laughter)—because, like the educationist, he did not see the result of his own errors, or yet the benefit of his good work.

Lord Kinnaird, honorary president of the Society, in his reply, referred to the more hopeful future of forestry in this country. He spoke of a meeting which owners of woodlands in Perthshire and Angus had recently had with Sir Roy Robinson, head of the Forestry Commission. Sir Roy had indicated that the country looked in a large measure to the privately-owned woodlands for necessary supplies of timber in the future, and he had asked the meeting for suggestions. They were grateful that the Forestry Commission should take that practical interest in them, and they believed that something might come from it.

WOODLAND OWNERS ASK ADVICE

In response to Sir Roy Robinson's invitation, the meeting suggested that some financial help should be given by the Government in the form of a grant towards the maintenance of woodlands, which would make it possible for the owners to put vastly greater areas under afforestation. The Government said that they wanted woods, and that they wanted privately-owned woods, and the owners said they were prepared to find these woods if the Government made it possible for them. The other suggestion made was that there was a demand on the part of owners for information and advice, and what was asked for was that the Forestry Commission should appoint to every area forestry officers, who would come to them and give advice. Again and again it was said by owners: "We do not know what to do; we do not know what to plant; can't you help us?" If they had trained men who could help them in that way it would be found that their advice would be welcomed, and woodlands would be improved, and they would have Scotland and England producing the timber they could.

Professor E. P. Stebbing also replied to the toast.

DUTY OF POLITICIANS

Sir John Sutherland, C.B.E., who replied to the toast of "The Guests" (proposed by the chairman), said he had never ceased to believe in the future of forestry in this country. It had had a most disastrous time but still the prospect was infinitely better to-day than it ever was before. He agreed that the question of private

woodlands was one which required attention. Wherever they went, the outlook was not of well managed, well-cared-for woodlands, and whether the State came to the aid of the private owner or not, he thought it was the duty of every politician to strive to find proper protection and proper treatment for all the wood in this country. For only within the last two months they had had a lesson: they never understood what it was not to have sufficient timber growing.

Other toasts were:—"Edinburgh University Forestry Society," given by Mr. A. Spiers and replied to by Mr. A. N. Pringle; "Kindred Societies," proposed by Mr. P. W. Leah, and acknowledged by Mr. Erskine Jackson; and "Alma Mater," submitted by Mr. G. Paterson, and responded to by Professor Sir William Wright Smith.

THE GROWING OF TREES IN GROUPS

Earlier in the evening, Lord Kinnaird delivered his presidential address to the students at the Forestry Department, George Square, taking as his subject: "Natural Regeneration of Woodlands." In Germany and Denmark, he said, he had seen many instances of the greatest use being made of natural regeneration, whereas in Scotland and in England very little use seemed to be made of this method of sustaining the forests. He thought they should study that subject more than they were doing. He referred to some of the disadvantages of ordinary planting, one of which, he said, was that they were apt to get far too pure a crop. He believed that if they could keep their crop very much more mixed than was the case in most of the plantations, it would have great advantages both from the point of view of the soil and from the point of view of the treatment of the woods later on.

Proceeding to point out some of the advantages of natural regeneration, Lord Kinnaird said that one thing that Nature seemed to do was to give trees in groups a much closer growth. He had watched these trees growing in groups, and he had found that in sycamore or ash planted by Nature, and about twenty years old, they got perfectly clean stems running up to about fifteen feet, and he had also observed that Nature had a marvellous way of spacing her trees.

HELPING NATURE IN HER WORK

In natural regeneration they got quality in timber, which was very important, and they avoided the danger of disease from side

prunings. They could not grow hardwood under favourable circumstances if it was mixed with other conifers. He believed that better results were obtained by growing trees in groups from natural regeneration than by planting them out individually.

Making a plea that they should help Nature in her work, he suggested that the large number of acorns which were eaten by pigeons should be saved. They should be collected and kept under favourable conditions till they were ready to sprout, and then planted out. His Lordship again emphasised his belief in the growing of trees in groups, and said that if this method was followed they would have a much healthier soil than they would have with only one species."—*Scotsman.*

GERMAN FORESTRY

The following review appeared in *Nature,* Vol. 142, Saturday 1st October 1938:

German Forestry. By Prof. Franz Heske. Pp. xxv + 342 + 16 plates. (New Haven: Yale University Press. London: Oxford University Press, 1938) 14*s.* net.

"This is a large book of 342 pages, and has been chiefly written for the American forester. Dr. Heske deals chiefly with forest economics and policy. The character, extent and ownership of forests in Germany, the growth, production and utilization of wood materials, and the general public services of the forests in the protection of watersheds, in the conservation of wild life, affording recreation and in maintaining industries, employment and stabilizing communities. An interesting fact is stressed. Until recently, the management of the forests was under the different German States, with a consequent difference in policy. A greater measure of control of policy by the Central Government is now being introduced, a factor which is all to the interests of the country as a whole.

The new departure in such well-established forestry countries as Germany and the former Austria would appear to merit close attention in India, where the devolutionary pendulum has swung so strongly in the contrary direction."

HARAR (TERMINALIA CHEBULA) CULTIVATION IN THE PUNJAB

BY R. S. CHOPRA, P.F.S.

PUNJAB FORESTRY NOTES, NO. 4, MAY 1937

The *harar* tree (*Terminalia chebula*), Sanskrit *haritaki*, needs no introduction to the Indian public for it is found in many parts of the country and its fruit has been used medicinally and for dyeing and tanning since time immemorial. The *harar* (fruit) forms an important drug of the ancient Hindu *materia medica* and to this day is being extensively used for a variety of diseases. There is hardly a household which does not stock *harar* fruit for some purpose or other. Sanskrit writers describe the fruit as laxative, stomachic, tonic and alterative; and the practitioners of *Ayurvedic* medicine use it for fever, cough, asthma, diarrhoea, urinary, skin and heart diseases, for enlarged spleen and liver, etc. Dried and powdered fruit pulp is also used as a dentifrice, to cure bleeding and ulceration of gums, its paste for sores and ulcers and lotion as a cooling bath for eyes. In combination with *behara* and *anwla* (the fruits of *Terminalia belerica* and *Phyllanthus emblica*) it forms the famous *triphala* (three fruits) which is commonly used by the *hakims* as an adjunct to other medicines in almost all diseases and is available from the *pansari* (the Indian drug vendor) throughout the country. The bark, the leaf galls and the oil obtained from the fruit kernel all have their medicinal use. The medicinal properties of the fruit were so highly esteemed that it received the name of *pranada* or life-giver and *suda* or nectar and the tree was assigned a mythical origin. The Hindu arch-vaid, Dhanvantri, is portrayed holding a *harar* fruit in the palm of his hand as an emblem of its being a panacea of all human ailments.

The Greeks and Mohammedans, like the Hindus, highly extol the virtues of the drug and use it on various diseases. It is the *Unani* (Greek school) physician's favourite for diarrhoea, dysentery and as a purgative to adjust bile and phlegm. Its therapeutic value has also been recognised in the European medicine system as combining a mild purgative with carminative and tonic properties.

In modern times the chief commercial value of *harar* fruit lies in its use as a tanning material for dyeing cotton, wool and leather. The chebulic myrobalans form India's most valuable contribution to the world supply of tanning materials and are exported in large quantities every year to various countries. The value of this export trade in 1935-36 amounted very nearly to Rs. 47 lakhs. In consideration of this enormous export trade and high consumption at home the extension of cultivation of this tree deserves special attention.

In the Punjab the tree occurs in the Sub-Himalayan tract from the Ravi eastwards up to 4,000 feet elevation. In the past it was extensively cultivated in Kangra district and also in the Siwaliks but public interest in growing the tree has gradually diminished. Many old *harar* gardens are reduced to a few over-mature trees dying for want of upkeep and replacement of casualties. The number of trees in the forests and waste lands has also decreased through lack of natural reproduction which is mainly due to wholesale removal of unripe fruit and neglect of young plants. Unsorted seed sells now for about 12 seers per rupee in Kangra. The collection of *harar* fruit provided a well paid employment to many poor villagers in the eastern Punjab and this important source of additional income will be lost to the rural population unless people realise the necessity of growing more trees and take active steps to replace the old decaying stock. The tree is easy to grow and does not require much looking after. Its method of cultivation is described below for the benefit of those interested in it.

Characters and requirements of the tree.—The tree is a light demander, *i.e.*, it requires direct overhead light and would not do well if planted in a cramped position. The young plants, however, appreciate a certain amount of shade and benefit by side protection from the hot sun. *Harar* will grow in places with rainfall over 25 inches and maximum shade temperature varying from 90° to 118°F. and minimum from 30° to 60°F. It is frost hardy and drought resistant to a great degree and also withstands fire well. *Harar* trees have been found to possess a remarkable power of recovery from scars and burns after a fire. As regards soil requirements the tree will grow even on poor rocky ground but here it remains stunted in growth. On deep sandy loam or clayey loam soils it reaches a large size and yields a good fruit crop. The climatic conditions of the east Punjab

plains and foothills are admirably suited for its growth and here the tree could be widely cultivated with profit round villages, in waste-lands and on roadsides, etc. Besides the economic value of its fruit, the tree yields a hard, strong and durable timber for house building and agricultural implements. Its green leaves form good fodder for cattle. With its low spreading crown and large leaves it forms an excellent shade tree. There may be objections to its planting for ornament and shade on account of its deciduous habit but the tree is leafless only for a short period in winter. New leaves appear early in spring and are soon followed by spikes of pale green flowers. The tree enjoys another advantage in coppicing well. When a particular tree is accidentally disfigured or broken by windstorm all one has to do is to cut the stem flush with the ground. Fresh coppice shoots spring up from the stump to take the place of the mother tree in due course.

Method of Cultivation.—The tree can be raised by sowing the seed directly on the site or by transplanting from the nursery. In view of poor germinative power of the seed and its liability to attack by insects, rats, etc., direct sowing is not recommended. It is best to raise stock in the nursery first. For raising stock the use of fresh ripe seed is very important as it spoils if kept long. Ripe fruits should be collected from the ground as soon as they fall and not off the trees. The fruit should be thoroughly dried by spreading in the sun and the hardened fleshy covering removed prior to sowing. The stones should be sown early in spring in wooden boxes or earthen pots, buried in the soil to a depth of 1 inch or so. Ordinary clayey loam or sandy loam soil will do, and no manuring is required. The boxes or pots should be kept under shade and watered regularly. The plants are kept in the nursery for one season and are planted out where required during the rainy season in the following year. Care is necessary in lifting the plants from the nursery and planting them out so as not to injure the tender roots.

The growth of the plant is rather slow but when once established it needs little attention. Cattle guards are essential to save the young plants from being nibbled by animals.

Fruit gathering and grading.—The tree bears fruit in winter. The collection of the fruit crop deserves some care as the medicinal

uses and tannin contents of the fruit vary at different periods of its life. The Greeks, Mohammedans and ancient Hindus distinguished the following kinds of fruit gathered at different stages of maturity:

(1) *Halileh-i-zira* (*Halileh*—Persian for *harar* fruit). Gathered when fruit is first set, about the size of *zira* (Cumin seed) when dry.

(2) *Halileh-i-javi*.—More advanced; of size of *jao* (barley corn).

(3) *Halileh-i-zangi or Halileh-i-aswed*.—A still further stage, when dried the fruit is black in colour and of the size of a raisin.

(4) *Halileh-i-chini*.—Gathered when the fruit has attained some degree of hardness and when it is greenish yellow in colour.

(5) *Halileh-i-asfar*.—Very nearly mature nut but still strongly astringent.

(6) *Halileh-i-kabuli*.—Quite mature fruit.

Up to this day Nos. 2, 3 and 6 are in general use for medicinal purposes and Nos. 4 & 5 for tanning.

The utility of collecting fruit approaching maturity (Nos. 4 and 5) for tanning has also been established as a result of scientific research. The percentage of gallo-tannic acid, the active tannin principle, has been found to be appreciably higher at this stage than in the ripe or very raw fruits. Accordingly plump, solid, oblong myrobalans of pale greenish yellow colour, free from dark blotches and worm holes are recognised to be the best for tanning. The *zangi harar* and fresh ripe fruit, smooth, dense, heavy, fat and round with small seed and an abundant pulp is highly valued for medicinal use. It is therefore in the interest of fruit collectors to grade their fruit properly and not to mix up the different commercial varieties. They are sure to realize a better value if the fruit is graded according to kinds 3 to 6 above.

The following information is taken from the accounts relating to the *Seaborne Trade and Navigation of British India* for November 1938 :

IMPORTS

ARTICLES	MONTH OF NOVEMBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
Siam ..	64	32	24	6,789	4,311	2,456
French Indo-China	498	159	134	46,400	18,486	16,247
Burma ..	..	13,954	12,435	..	18,59,613	16,03,986
Java ..	286	..	..	29,127	..	..
Other countries ..	..	711	582	..	94,180	66,730
Total ..	848	14,856	13,175	82,316	19,76,590	16,89,419
Other than Teak—						
Softwoods ..	641	1,259	1,300	25,158	87,345	79,336
Matchwoods ..	1,282	687	891	76,533	47,767	55,105
Unspecified (value)	..	..	..	18,377	3,00,739	2,68,988
Firewood ..	71	66	75	1,065	996	825
Sandalwood ..	41	..	54	11,344	..	12,452
Total value ..	..	..	..	1,24,100	1,36,108	1,47,718
Total value of Wood and Timber ..	..	..	..	2,24,793	24,13,437	21,06,125
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	180	72	..	13,557	8,273
Plywood ..	242	373	1,007	63,283	79,348	1,70,543
Other manufactures of wood (value) ..	..	..	..	1,13,604	1,77,047	1,28,867
Total value of Manufactures of Wood and Timber other than Furniture and Cabinetware ..	..	..	..	1,76,887	2,69,952	3,07,683
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	20,963	9,168	25,186	1,42,178	77,146	2,11,378

EXPORTS

ARTICLES	MONTH OF NOVEMBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	4,659	28	..	9,64,915	3,391	..
,, Germany ..	182	..	..	47,316	..	..
,, Iraq ..	49	10	18	12,204	3,583	6,993
,, Ceylon ..	220	..	..	39,026	..	..
,, Union of South Africa ..	353	..	..	68,269	..	..
,, Portuguese East Africa ..	288	..	..	49,214	..	..
,, United States of America ..	38	..	..	10,331	..	..
,, Other countries	351	54	416	72,842	16,784	1,68,310
Total ..	6,140	92	434	12,64,117	23,758	1,75,303
Teak keys (tons) ..	147	..	..	17,107	..	..
Hardwoods other than teak ..	92	..	..	8,934	..	..
Unspecified (value)	..	..	..	59,107	25,929	30,535
Firewood ..	..	..	..	..	..	..
Total value ..	..	..	..	85,148	25,929	30,535
Sandalwood—						
To United Kingdom	2	1	..	1,600	1,200	..
,, Japan ..	10	21	..	12,000	18,100	..
,, United States of America ..	50	51	..	60,000	50,000	..
,, Other countries	13	18	11	14,781	16,040	9,337
Total ..	75	91	11	88,381	85,340	9,337
Total value of Wood and Timber ..	..	..	..	14,37,646	1,35,027	2,15,175
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	18,350	19,932	11,016
Other Products of Wood and Timber		No data			No data	

INDIAN FORESTER

MARCH 1939

TEMPORARY GRASSLAND

Professor R. G. Stapledon is a renowned advocate of a system of agriculture which provides for grassland by leys (a ley being land sown with grass and used for the production of grazing, hay or silage only for a definite number of years so that it takes a place in a regular rotation with other crops). So convinced is Professor Stapledon of the importance of this method of farming that he spoke on "Ley-farming and a long-term agricultural policy" at his Presidential address to the Agricultural Section of the British Association for the Advancement of Science at Cambridge in 1938. He advocates three basic principles as fundamental for a rational agricultural policy. These are the maintenance of as large and contented a rural population as possible; maintenance of the largest possible acreage in a highly fertile and always ploughable condition; and thirdly, farming methods which permit of the maximum flexibility in commodity production. His arguments in favour of leys are that thereby flexibility for commodity production and the needs of the soil for maintenance and enhancement of fertility can both be brought to their maximum. Similarly maximum provision will be made for constant employment of labour and for production of forage. In comparison, permanent grasslands increase the need for reliance upon imported food-stuffs, both for human and animal consumption. Never being brought under the plough, they yield no corn and produce less grass through the natural increase of weeds. The natural fertility maintained in the soil by a suitable rotation of cash crops, fodder crops and grass for grazing also compares more than favourably with permanent arable which must be dependent on extraneous sources for artificial or organic manures.

It is in this matter of soil fertility that Professor Stapledon's ideas impinge upon methods of management for much of the land under the control of the Forest Department in India. A considerable percentage of this land is sub-marginal, as much for forest crops as

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for arable, on account of the demand for grazing for herds of cattle from neighbouring villages. Whether or not such land was intrinsically so poor, excessive and uncontrolled grazing over a long period has reduced it to a state in which fertility is negligible and restoration is an urgent necessity. In many parts of the country the cry for more land for cultivation is also loud, insistent and urgent. Maximum utilization both for production of fodder for cattle and of corn crops for human maintenance is, therefore, an economic necessity. With such poor soils, however, the greatest care is essential lest ruination should occur of what little fertility they possess. Soil structure and plant cover are intimately connected. The essential point to achieve is a proper balance between periods of cultivation with rapid oxidation, leaching and degradation of structure, and restoration periods under a vegetational cover leading to granulation of the soil, the return of nutrients to the surface and the production of active colloidal organic matter. Forest crops are obviously ideal for the second of these two objectives and with very poor soils a lengthy period under such treatment, such as is necessary to allow a forest crop to reach maturity, may well achieve the proper balance against a relatively short period under cultivation.

Surely it should be possible to evolve an ideal rotation which would combine a tree crop with arable cropping and also with grass leys for fodder production and grazing. The tree crop could be put down in lines at the time of cultivation in the ordinary *taungya* method. Grasses could be sown so as to follow the corn and be cut for fodder for two or three years while the trees grew up above damage by grazing animals. Then finally grazing could be allowed until the tree canopy became too dense for grass to flourish. Alternatively, or perhaps additionally, the tree crops could be opened up before being finally harvested to an extent sufficient to allow grasses to invade the area. The grass crop could then be grazed for a few years before the tree crop was felled and thereafter the land would be put under cultivation. In this way organic manure would be returned to the soil through the droppings of the animals as they grazed and be available to strengthen the corn crop as soon as cultivation commenced. Field experiments on these lines might yield valuable data In dealing with such subjects, however, one fact must never be forgotten: results are essentially only local in applicability.

FOREST ADMINISTRATION REPORTS

By E. A. Smythies, I.F.S.

Summary.—Forest Administration Reports are usually extremely dull reading, and filled with a mass of minor details and relatively unimportant matter. They would be more interesting to legislators, the general public, and to other provinces, if unimportant details were omitted, and greater attention paid to important matters of policy, and to trends of administration and developments.

With the advent of popular Governments in all provinces of India, the necessity for propaganda has greatly increased. The Forest Department, which administers chiefly the sparsely inhabited tracts of country, and whose work, therefore, is not so well known to the bulk of the electorate as that of other Government departments, has few opportunities for propaganda, and therefore should be the more careful not to lose any opportunities it has. One of these is—or should be—the annual forest report of the province. But are these, as at present drafted, of much value for propaganda? Emphatically No! Opinion, even among forest officers, is unanimous that they are, generally speaking, extremely dull reading. They are compiled, in the majority of provinces, from two or more Circle reports, which again are compiled from a number of divisional reports. Now divisional reports, quite rightly, contain a mass of information, of interest to the division, such as record of petty disforestations, plantation failures and the like, which are of little interest in a Circle report, and still less so in a provincial report. And yet, how often does one read in a provincial report that .02 acre was disforested in the Huggermugger division for erecting a latrine, and 100 teak cuttings in the Mumbojumbo range failed to shoot? My first suggestion is that all details should be eliminated from a provincial report which are not of provincial or extra-provincial interest.

Further possibilities of elimination occur in some of the annual code forms, such as Settlements (8), Boundaries (9), Surveys (10), Causes of forest fires (15), Depots (21), Stocks (22, 23), Outstandings (26). In many provinces where forest reservation has long since been completed, the first three items above are now of little importance, while in provinces with little departmental exploitation, the last three are also of little importance. Even if they are prepared for record, there is little purpose in publishing them annually.

Having cleared a lot of junk, let us see how best to utilise the space.

I suggest that in future forest reports should aim, to a much greater extent than hitherto, on giving information, both to forest administrations in other provinces and to members of the Legislature and the general public in the province, on a number of important points, which at present find little or no reference in these reports. For example—forest policy. What *policy* is being adopted by the popular Governments as regards deforestations on a large scale, on revision of forest settlements and rights, on further concessions of grazing and timber, on expansion of forest industries, on control over waste lands and private forests outside the Government reserves, on erosion and flood-control generally?

Again, what attitude and action are provincial Governments taking over forest education and training, and on what scale? Or, again, what attitude and action over expansion or further retrenchment of forest staff, both superior and inferior? Or over research and working plan revisions? Or over forest finance generally?

Again, to what extent (if at all) is the Forest Department co-operating with other departments and authorities, *e.g.*, with the Irrigation Department in the management of canal bank plantations, with the P.W.D. and District Boards in the management of road-side avenues, with the Rural Development and Revenue Departments in the better use of waste lands and prevention of erosion?

I believe that by greater attention to these and similar matters, combined with the elimination of petty details and of information of only local importance, we can make our annual reports more interesting, more important, better propaganda, and more useful to other provinces. Anyway, acting on this belief, I drafted the 1937-38 annual report for the United Provinces on the lines indicated in this brief note; this is in the Press, and should be issued shortly; and it will, I hope, illustrate the ideas which I have tried to bring out in this article.

RESIN TAPPING IN KUMAON

By F. C. Ford Robertson, B.Sc., I.F.S.

Part II—Notes on Research and some Recent Field Studies bearing on Future Resin Supply—(*concluded*).

50. Let us now take stock of the situation confronting us. In a sense, no "crisis" exists. What we in Kumaon are really up against, without having realised it, is an earlier and pretty wholesale swing-over to interspatial tapping in respect chiefly of the middle-sized class of tree; an important, because numerous class in our tapping stock. This development, however, is bringing its own problems. The past five years have seen such trees abandoned as "exhausted" in ever-increasing thousands. Indeed, on this score alone, my special counts for the 1938 season (see para. 9) revealed casualties among 1937 trees in the neighbourhood of one-third of a lakh; a figure in excess of the year's recruits and independent of all losses due to rights, petty sale, windblow, etc. Such defections, serious in the aggregate, were too widely scattered to focus attention until the camouflage of a false recruitment got stripped away by the careful enumerations of 1936 and 1937. But they are now forcing themselves on our notice in quite another and unpleasant fashion.

51. Tappers are under contract to keep their tapped trees cleaned basally against fire. Since abandoned trees no longer get this protective *jar safan*, every controlled burn is converting more and more of them into standing resin torches, pathetic derelicts whose blackened channels lay a trail of yellowed resin-drip for the next fire, in a vicious cycle of destruction. The sooner, therefore, we resume *jar safan* on these inflammable and vulnerable outcasts from our crop the better; and as this costs money and can never in any case offer complete protection, it would seem bad business not to resume tapping on such trees at once and in future "cash in" on the interspatial cycle without a break. To pervert a famous couplet, it's a matter of "Gather ye resin while ye may. . ." in our fire-swept forests: every further face exposing the tree commits one more extensively, for one way or another the fire-bogey can never be satisfactorily laid. And there seems further trouble ahead, trouble not confined merely to the increasing vulnerability of our tapping

capital. I mean the question of yield, or, more precisely, of resin productivity, during and in particular towards the end of the interspatial cycle.

52. So long as we tap between excessively spaced primary faces, even the total loss of callus may matter little. But thereafter? The best expectation of 30 years growth and healing allows barely two inches of tissue on either side of a channel cut between a pair of properly spaced primary faces. The curvature of the callus certainly increases the effective conduction tissue but against this must be set the 6″ up-curved lip which bites $\frac{3}{4}$″ into both sides (see plate 7). Moreover, we can depend neither on optimum growth nor 30 years of it, as I have shown; while it will be seldom, surely, that we can site our interspatial lips so as to take advantage of the abnormal healing characteristic of the old lip insertions—basal channels being the most likely to serve us with a pair of these. At best, neglecting all future fire hazard, I think we must be prepared, as in the case of the close-cut channels on a tapped-to-death tree,* for a marked decline in yield under such constricting conditions. Primary faces are flanked by a full $4\frac{1}{2}$″ of virgin tissue and a less completely channelled bole—surely a big nutritional difference. It is largely for this reason that interspatial tapping expectancy has been curtailed in the table in para. 42. The class of tree there shown will, of course, be the first to peter out finally, *i.e.* after its truncated secondary tapping cycle has finished, leaving subsequent recruits and the older stock to serve us until the channels drop to something less than eight per acre. Before this happens we shall be well advised to introduce multiple tapping in such a way as to exhaust all girth classes simultaneously.

53. How long our oldest tapped coupes can last, with continuance by interspatial tapping, remains a matter for investigation on the general lines of my tapping life counts. We have, at any rate, reason to shorten our expectations substantially: for the sort of forest God and man have given us in Kumaon the indications are a total tapping life of some 50 to 55 years except in the worst incendiarised areas. I discount, from personal trials on healed over faces the practicability thereafter of callus tapping.

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* Only a 2″ interspace in Kumaon. (See figure 22.)

54. What implications does this hold for our resin management? Superficially considered very little. Broadly speaking, we tap trees when they reach anything from 65 to 80 years of age and fell at 100 to 120, or about a fifty-year span. It is here, however, that the actual facts of the situation obtrude uncomfortably.

55. Take this division, from which comes three quarters of the Kumaon resin. So markedly abnormal and irregular is the growing stock that our tapping orbit comprises practically the whole of two Working Circles, containing such an excess of the older age classes, as well as overmature stock, that over 90 per cent. of their area is and has long been under tapping. Had these circles been normally constituted—and they are in process of conversion to uniform on 100 and 120 years rotations, one of them, indeed, since the 1890's—only about one-half of each would be tappable at any one time.[1] And although the *Quartier bleu* system under which we work does not differentiate the younger periodic blocks, one knows that somewhere or other in the growing stock are areas destined to form the "tail" of our conversion period, areas whose abnormally old stock has still to last the better part of a century: the timber may do so but certainly not the resin. Even our optimists, toying with data inclining them to a *reduction* in our minimum tapping girth limit, did not envisage more than 70 years continuous resin output!

56. The more, indeed, one considers the matter, the more it becomes evident that this Kumaon resin business has all along been "living on its fat." Even now, most of the converted compartments, which we consign to P. B. Last, retain groups of advance growth that add sufficient recruits to the remnant of standards (retained in blanks) to keep such coupes under tapping [2]—such advance growth indeed, gets roped in even before regeneration fellings. Thus, in the Commercial Circle, the few thousand acres of P. B. Last still carry nearly a quarter lakh of resin yielders, one third of these being trees below 4′ bhg.; while P. B. I holds another 11,000 of them, most of which will be carried over to the new crop. The "fat," here,

(1) Stand Tables, vide I.F.R. (New Series), Vol. II, No. 3, pages 66 and 68 show that III Q. *chir* crops produce 8 trees per acre over 3½′ bhg. just before 70 years and II Q. crops at about 55 years. Assuming .8 stocking, crops of II-III Q. should, therefore, allow tapping in their early sixties.

(2) Current and past conversion plans retained trees of 3½′ bhg. and more, as part of the future crop.

is getting thin and in many compartments must soon fizzle out (too few channels left per acre); while over the rest of the growing stock—the other P. B.'s with their over-load of large stems—it has been liquidated more than most folk realise by the multifarious influences for loss we have already discussed. As more and more of our present stands emerge from the conversion machine, carrying less and less of the present "advanced" advance growth, future D.F.Os' will have to be content with a steadily dwindling proportion of resin yielding forest per working circle, until, reaching approximate normality of age classes, they and the industry become reconciled to a far longer average lead to railhead and a much greater dispersion of work than we now enjoy.

57. In compensation let us hope—against hope! for all the omens are bad—that we shall be permitted to bequeath to them a higher proportion of healthy, normal trees per acre—regularly thinned, full-growing stands free from crookedness, slant and chronic fire-injury, and tapped. moreover, on a single consistent system of channel alignment. Under such favourable conditions, they might even be justified in a slightly lower girth limit; for their trees, granted the same rotations, will have a shorter run.

58. Which brings me to another point. We in the United Provinces have never attempted, at least since the era of continuous tapping, to work our resin forests for a sustained yield in value in the sense we do other important produce, like timber. Tied to our resin Agreement we have always tapped the most accessible areas, even long before there were any grounds for believing, as for years we have been, that they would remain productive indefinitely. Resin has has no proper working plan, no grouping of coupes by economic water-sheds and zones (tapping series), and then tapping portions of these in turn. The fact that resin working is complicated by a fluctuating demand, by considerations arising from *pari-passu* timber fellings and by much else, surely makes some sort of plan all the more necessary. In the much more normally constituted forest that we are in process of creating, the presence of regular stands of known tapping potentiality should simplify matters, although their grouping and location, being fortuitous, may prove very far from ideal.

59. Finally, if my reading of the situation be correct and a large proportion of our present resin capital is doomed to final

exhaustion within no long period, what, if anything, can we do about it? Not, perhaps, very much. For we have already eaten our cake, or rather bolted it. But I have a few suggestions to offer, good, bad and indifferent. I hope they will provoke others—

(*a*) *As regards our new growing stock (in P. B.'s I and Last).*

(*i*) In future, stop tapping the advance growth not later than the final fellings; we should conserve this residuary resin capital against leaner times ahead. By the same token, in our existing P. B. Last and finally felled areas multiple tap the remaining standards now, cashing in quickly on their resin capital, and stop all further tapping as soon as they are exhausted. The chief snag here has already been mentioned—the expense and uncertainty of fire protecting trees on which tapping has been suspended. While we are at it, though the point is a minor one, we should nowhere neglect opportunities of tapping suppressed and dominated stems from, say, 2′ bhg., as they do in the U.S.A. Our jungles being unthinned we leave a lot of resin unexploited by our present rigid tapping limit. Such trees may also help to keep near-exhausted coupes alive.

To the whole body of young, developing regeneration, which has a long period to grow before reaching tappable size, our duties appear to be clamant and vital, the more that they have been neglected so long:

(*ii*) both clean and thin regularly and thoroughly so as to minimise fire damage and get good crowns, with all that this means in higher (and earlier) yields, increased rate of callus formation and resistance to fire. We got going on this in Kumaon last year over considerable areas, at a cost of some ten annas per acre.

Query: How much would we be justified in spending on this? Good silviculture can become bad economics.

(*iii*) Re-organise, which really means regain control of, our so-called "controlled" burnings, preventing their all too-ready degeneration into a burnt offering on the altar of fire-protection, and so save our young growth from its present repeated scorching. If there were no other ills—and too much reliance can be placed on the *chir's* thick bark—the cumulative check on increment may be serious, as foreign studies convincingly demonstrate. This continual, insidious grilling of our tender young trees seems a poor exchange for the honest-to-goodness holocausts of the pre-control-burning period, which

at least patently advertised their destructive effects and prompted a remedy.

> *Query*: Here again, how much damage must be tolerated on grounds of expense? Large areas are involved, we burn repeatedly, and we have no clear idea—it may be just as well—of what damage we do by it.

(*iv*) Achieve a measure of forest grazing control, both as to incidence and distribution, more especially in the herd-ridden New Reserves, so that neither trees nor cattle need be doomed to starve and stultify together on depauperated, hoof-scarred ground.

Both (*ii*) and (*iii*) above require cash, which in some measure the resin industry can and must afford; (*iv*), no doubt, calls for the courage and spirit of an Augean mission, with forceful Departmental propaganda against that endemic and pervasive pastoral ill—hand-to-mouth disease. Surely we can produce this too.

(*v*) As a positive, constructive development from (*iii*), modify our controlled burning procedure so as to bring in and foster advance regeneraton in (*a*) unfelled P.B.I's (*b*) maturing unallotted areas—*i.e.* likely candidates for the next *Quartier bleu*. A lot of this can be done in our poorly stocked forest without major fellings or loss of existing resin capital. I have already started on (*a*)—doing what we call "piecemeal" burnings—in West Almora division.

(*b*) *As regards the old growing stock* (*under conversion*):

(*i*) Discover as soon as possible the potentialities of re-tapping *i.e.* deepening last year's channels (see para. 31). Next to this our most paying resort would appear to be thinner freshenings, which would save us the two bites at one cherry—or channel—and a certain amount of face dryage. Experiments in the U.S.A. with $\frac{1}{4}''$ freshenings show practically the same yield for the same period, plus a gain of two extra years of tapping per face. It seems reasonable to expect a similar response from *chir*. But with our labour conditions and country-made tools to what extent would this refinement be practicable?

(*ii*) Determine the minimum acceptable dimensions for tapping an interspace. This should constitute a neat little piece of research involving very accurate *thokan*, channel cutting and weighments of

DIAGRAM OF AN INTERSPATIAL CHANNEL C, CUT 30 YEARS AFTER THE PRIMARY CHANNELS A & B.

(1) Reasonable increment and callus growth allowed for
(2) Optimum growth figures would be – Interspace 6" instead of 5½"
Callus 1" (each) instead of ¾"
making width of secondary interspace 2" instead of 1½"

SCALE 1" = 4'

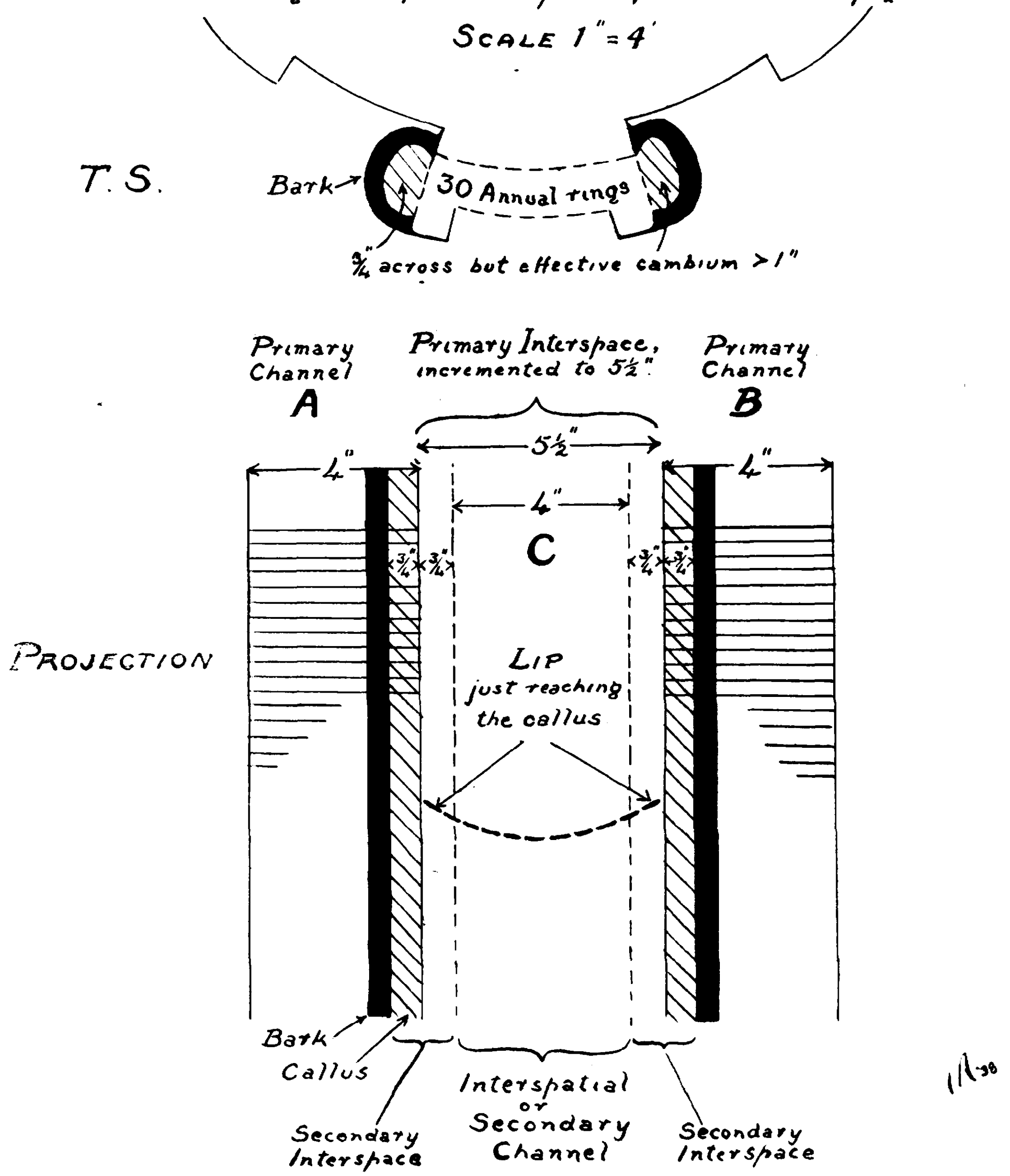


Fig. 20.

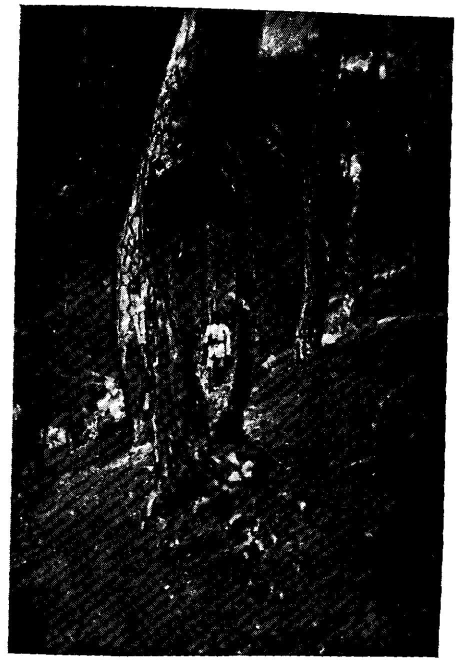


Fig. 21.

"... standing resin torches ..."

Two stages in the fate of abandoned trees. On the left incineration has begun. On the right hacking for torchwood (**chilka**) has abetted the work of fire. Moral: Change over to interspatial tapping without a break.

Fig. 22.

"... crowd'em on two inches apart ..."

Careless cutting, no allowance for taper and sundry scorchings have reduced several interspaces on this tree to an inch or less of desiccated tissue. At the pointer, two lip cuts have crossed. Pot yield reported of the poorest.

Photos by author: Copyright reserved.

yield. We shall meanwhile be gathering lots of empirical data about this as our interspatial cycle progresses: the broader interspaces won't last us very long.

Next, a commonly heard suggestion, one sufficiently near practical politics to set me doing special enumerations in the cold weather of 1937, so I propose to enlarge on it—

(*iii*) Stop tapping the $3\frac{1}{2}$ to 4′ girth trees; in fact, *raise the minimum girth limit to 4′ everywhere.* Starting on trees with six inches more waist-line might just reconcile theory to practice and allow a 70-year span of continuous tapping on present dimensions. Let us look into this. First, can the Punjab, who have not so far as I know departed from their 4′ minimum, give us a lead here? It will interest them to learn that nearly one quarter of the stems tapped in this division during 1938 were below 4′ bhg.—the actual figure being 2,72,000; a nice bunch of trees to lose! Secondly, uncounted numbers of these are poor, stagnating trees, showing many more years of channelling than their size warrants. What purpose in suspending work on these? Thirdly, even on average growing trees with full bole-space available, may not the gain prove illusory? It means foregoing the yield on a numerous class of tree for anything up to 10 years in the hope of squeezing an extra decade of resin from them in their old age: and, more pertinent still, just how many of our compartments and coupes require to be spun out for so long? This measure seems one to be applied with the greatest circumspection.

I follow with its blood brother—

(*iv*) Reduce the breadth of channel slightly on the smallest class of tree so as to ensure an incremental face: a policy in fact, of smaller returns over a longer period.* This is for consideration alternatively to (*iii*), like it allowing for a larger, though not so large, total tree outturn but realised over an earlier span of the tree's life. While this seems the more attractive proposition, within the limitations indicated above, it raises the practical difficulties involved in applying two dimensions of channel in one and the same coupe.

*_Cf_ Udhampur division in Kashmir which has adopted 4″ faces and a 6″ interspace along with our minimum girth limit. This pattern precludes even a fifth primary face on the smallest class of tapped tree. *Tot homines* . . .

(*v*) Contrariwise, consider decreasing somewhat our standard interspace on stems offering no prospect of interspatial tapping, as, for example, a mature or overmature tree. This is perfectly feasible, since we are accustomed to working with different interspaces ($4\frac{1}{2}''$ and $2''$) and these involve no change in apparatus.

(*vi*) Put double channels on seedbearers and so keep seeding-felled areas, with their six to eight standards per acre, continuously under tapping. Up till now it has been one channel or none.

(*vii*) Resume advance heavy tapping in all regeneration coupes without delay—only, if you please, on more rational lines. Between the two extremes of "one-channel-per-year" and "crowd-em-on-two-inches-apart," which have long been my despair,—yes, and the resin mates' too—we might now grope towards a happy mean; something in the way of multiple tapping less likely to cause premature death, which may prove silviculturally embarrassing and seems in any case quite unnecessary, and at the same time nearer to the optimum pot yield for the period of advance tapping fixed. I see no reason to limit this, as hitherto, to five years, especially if, as many of us suspect, this period is uneconomically short, killing the goose that lays our golden—drops!

None, however, of the above expedients for husbanding or otherwise making the most of our present resin capital can be scientifically applied until we know with reasonable accuracy how long each coupe is going to last under the existing tapping regime and *how long we want it to last*. For this latter, if we do not require to allot the undifferentiated mass of our *Quartier Blanc* to a succession of periodic blocks, at least we should determine P.B. II. Our resin management demands a discrimination beyond that of timber

While, of course, everywhere we must—

(*i*) pay the strictest attention to all matters affecting accurate and economical channelling, as also to careful *jar safan* along with the controlled burning, so prolonging the interspatial cycle.

And

(*ii*) decide on one system of channel alignment *and keep to it*. With so much of our yield coming from twisted, crooked stuff, I trust this system wont be strict plumbline. This system has had a trial and, in my opinion, it has proved a sore one for Kumaon.

60. For the rest, we should never lose sight of the fact that prolonging the yield period is not an end in itself: that our channel dimensions are not swadeshi but imported, and that if the 100 mds. (or thereabouts) that we may reasonably expect from the average acre of *chir* forest in its fifty odd years of tapping could be harvested within a shorter span without prejudicing silviculture, we should welcome and exploit such method.

61. In conclusion, let me utter the heresy that our whole tapping technique has been suffering from overmuch rigidity and stasis, at least since the War. Simple rules may be necessary for simple workers but on matters like tapping intensity (number and dimensions of channels) we appear to have paddled along doing the same old thing from one lustrum to the next. The exigencies of the future, some of which I have indicated, require a new-found flexibility in field method, to which our staff and labour organisation must be adapted. In this division these are coping very satisfactorily with sundry new departures, of which the writer is generally the *enfant terrible,* and with judicious management they will, I have no doubt, respond to many more. Certain changes and innovations, I am convinced, are inevitable at this juncture and we should address ourselves to them. An industry that, year in and year out, yields us a profit exceeding Re. 1/4 per tapped acre (and has in the past given much more), that spares thrice that amount for the needy labour engaged in it and when all is done, allows almost cent-per-cent utilisation of the timber, deserves all the trouble and thought we can give to it.

(*Concluded.*)

THE IMPORTANCE OF THE ORIGIN OF SEED IN FORESTRY

By M. V. Laurie, Silviculturist, F.R.I., Dehra Dun.

The following is an abbreviated account of a lantern lecture delivered by the writer at a Staff Meeting of the Forest Research Institute on the above subject:

The area of plantations that is being made annually in India and Burma is approximately 46,000 acres, and the area of plantations of one kind or another now existent in India is round about 10 lakhs

of acres, representing an expenditure of crores of rupees. Hitherto comparatively little attention has been given to the origin of the seed used in plantation work, with the result that frequently the best possible results have not been obtained while occasionally it happens that very bad plantations are produced. Slides were shown comparing good clean-grown plantations of teak in some localities with very branchy and badly formed plantations in others, special attention being drawn to particular types of branching which appear likely to be hereditary characters.

The different types of variation that may occur within a species were then discussed and illustrated with particular reference to whether they were advantageous or otherwise from the point of view of raising plantations, mention being made of such evidence as is available regarding whether the variations are hereditary or due to other causes. Geographic racial differences were illustrated under the headings of altitudinal races, climate races and edaphic races,—with a fourth category topographical races including racial variations which could not be attributed to any of the above factors. As distinct from racial characters individual tree variations occurring in the same locality were also mentioned.

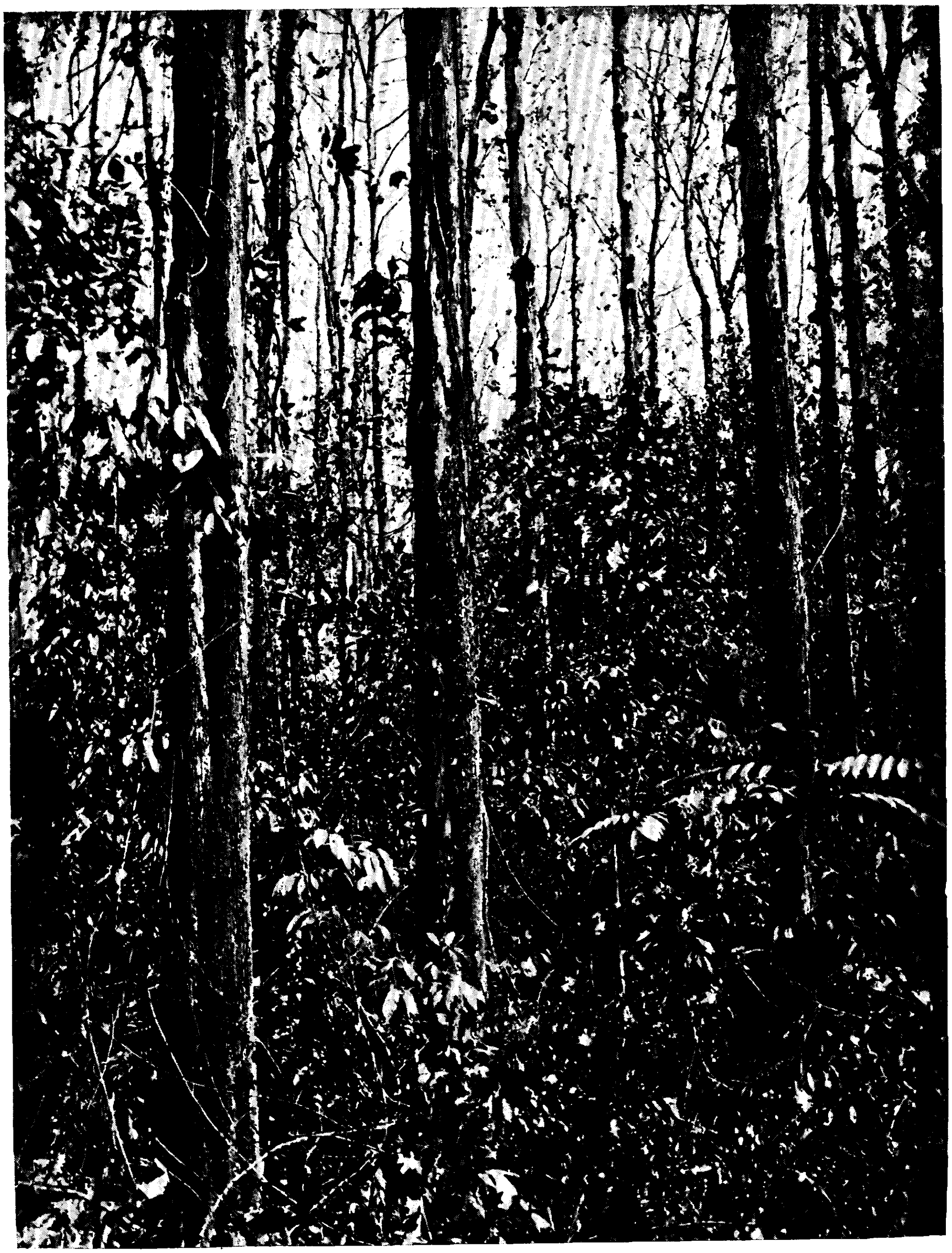
The different types of variation were then discussed in more detail. Under morphological variations illustrations and examples were given of differences in bole form and branching (teak, *Hopea parviflora, Acacia arabica*), leaf differences (*Terminalia tomentosa*, teak, *Diospyros melanoxylon*), fruit differences (sal, *Terminalia chebula* and *Anacardium occidentale* fruits), fluting, with illustrations of badly fluted and not fluted teak plantations, twisted fibre, with reference to the experiments of Mr. H. G. Champion who has proved that twisted fibre in *Pinus longifolia* is definitely inherited, and timber quality, examples being quoted of *Gmelina arborea* and *Lagerstrœmia flos-reginae* regarded as excellent timbers in Bengal and Assam, while considered rubbish in South India, the differences being probably chiefly due to the factors of the locality but possibly partly also racial. The two strains of *Artocarpus integrifolia* (jack-wood) one grown as fruit tree in the plains and the other the wild tree of the evergreen *ghat* forests at higher elevations were mentioned, the former having a good timber while the latter has a paler wood with a more woolly consistency that is not popular with timber

Branchy type of teak in plantation 34 years old, probably due to bad seed origin. (South Coorg).

Photo:—M. V. Laurie.

Normally clean straight well-grown crop of teak 15 years old. (Nedungayam, Nilambur Division).

Photo:—H. G. Champion.



40-year old teak plantation showing excessive fluting of the stems.
(Zigon Division, Burma).

Photo:—J. H. Lace.

merchants. Differences in case of seasoning or tendency of the timber to split were also mentioned, the example being quoted of *Terminalia tomentosa* from different districts in Madras varying considerably in its tendency to open up after conversion. While it was emphasised that such variations may, in most cases, be primarily due to local conditions affecting growth, there is also the possibility that hereditary tendencies may also play a part in producing them. The question of figured wood was discussed and mention made of the experiments that have been started to try and determine to what extent "figure" is inherited. Figured timber of species used for furniture, panelling, etc., commands fancy prices and if we could find out how to grow plantations of guaranteed figured wood, they would be exceedingly valuable indeed. In bamboos (*Dendrocalamus strictus*), congestion in clumps and solidity of culms are both suspected of being hereditary characteristics, experiments being in progress to verify this. The former is a most undesirable characteristic as very few saleable culms are obtainable from congested clumps, besides which such clumps are almost impossible to work. Completely solid culms on the other hand might be found useful for special purposes, so that a knowledge of whether this characteristic is hereditary or not might be of value.

Physiological, as distinct from morphological differences, often occur between different races, and probably also between different individuals of a species. The germinative capacity of seed, for instance, has been found to vary very greatly for different races of teak,—that from parts of the Central Provinces being notoriously difficult to germinate while seed from the moister regions of S. India is comparatively easy to germinate. The time taken to germinate also varies very greatly, a point which is of the greatest importance in artificial regeneration work, especially in the case of a species which is raised by direct sowing.

Inherent vigour and rate of growth has also been shown to vary and to be a hereditary characteristic in some cases. In America the tree breeding stations are concentrating in particular on isolating and breeding out strains of pines which are faster growing than the normal. In the investigations in India considerable differences in the early rate of growth of teak were experienced in all the different centres in which the experiments were carried out. Rapid early

growth is important as affecting the cost of establishing plantations and rapid growth in later life will give higher returns on the money invested. It is probable, however, that bole form and cleanness of growth are more important characters than mere rate of growth in cases where timber is the main product aimed at.

Resistance to adverse conditions is another quality which has been found to vary between different races and strains. For instance at Dehra Dun, Burma teak has been found to be more resistant to frost than any of the varieties coming from the Indian peninsula, those from Madras and Travancore being especially susceptible. In the Punjab exotic strains of *Prosopis spicigera* (especially a form from the Argentine) were found superior to the local strain as regards drought resistance and rate of growth. Very many instances can be quoted of racial differences in resistance to adverse climatic conditions, and a knowledge of such variation can be of the greatest value when attempting to afforest land under difficult conditions of climate or soil.

Resistance to fungus diseases has been shown to be a hereditary characteristic in agricultural crops, where resistant strains of most important crops have been bred out and are now in general use. In forestry tree strains of different degrees of immunity have been observed to exist but so far little work appears to have been done on this large and important field. Attempts are being made to isolate a strain of sandalwood in Madras that is immune from "spike" disease by using seed from the trees that have survived longest during an epidemic of the disease.

Variation in immunity from insect attack has been observed in Europe, and in India different strains of *Schleichera trijuga* and *Butea frondosa* exist which are reported to vary in respect of their palatability to the lac insect. The variation in suitability for raising silkworms of different strains of mulberry is also well known. Different strains of *Terminalia tomentosa* have also been observed to vary considerably in their susceptibility to attack by a leaf gall insect (Psyllidae). The considerable variations in the texture of the leaves of teak from different origins suggest that some of these may be more immune to defoliators than others, but this has not yet been tested. In view of these known cases of variation in palatability or resistance to insect attack it should be possible in many cases where

The four central poles from plantation raised from seed from twisted mother trees from locality where most trees were twisted. The two outer poles from straight grained parent trees growing in predominantly straight grained crops.

Photo:—H. G. Champion.

Typically congested clump of *Dendrocalamus strictus*.
(Hoshiarpur Division, Punjab).

Photo:—P. N. Deogun.

attack is serious to mitigate the damage by selection of strains having a higher degree of immunity.

It is interesting and somewhat unexpected to learn that individual trees of Southern Yellow Pine in America have been found that are comparatively immune from attack by mistletoe, and that resistant strains have been bred from them enabling crops of this species to be raised in localities where previously they were almost wiped out by the parasite. The immunity rests apparently in a thicker, harder bark, and this raises hopes that in localities where *Loranthus* is a really destructive pest (*e.g.*, in the *Gmelina* plantations in Bengal and Assam for instances), immune individuals might be found from which resistant strains could be bred.

Variation is known to exist between races and between individuals of a species in respect of their yield of valuable products. A well-known instance is rubber where high-yielding strains have been isolated and cultivated for many years now. Resin yield in *Pinus longifolia* is known to vary between individuals, and the heredity of this character is now being tested by raising plants from seed of high-yielding and low-yielding strains. Variation in yields of oils (*e.g.*, Sandalwood and *Eucalyptus*), of alkaloids and other chemical products (*e.g.*, quinine from *Cinchona*, ephedrine from *Ephedra*; santonin from *Artimesia*, rotenone from *Derris* and *Tephrosia*, katha from *Acacia catechu*, tannin from myrabolams barks, etc.) may similarly be expected, and high-yielding varieties should be looked for and preferred as a source of seed when any cultivation of the species in question is contemplated.

The different ways in which trees may be expected to vary have been indicated very briefly above. Some of the variations from normal are beneficial, some are the reverse but in many cases we do not know whether they are hereditary or not. At present in India we are beginning to realise that these variations exist and that it may be important to pay some attention to them. Most of the seed collection, however, that is done for regeneration work or for supply to other officers, is carried out by subordinates or coolies with but little regard to the type or form of the parent tree. The natural tendency in such cases is to prefer low branchy, wide-crowned trees that give the largest quantity

of seed and are the easiest and cheapest to collect from. The result is that the form of the trees in plantations is occasionally very inferior or that other undesirable hereditary characteristics appear as the plantations grow up, and that we are not making the best use of the opportunities nature gives us to improve our plantations and get the best value for the money spent in raising them. Experience in Europe of the disastrous results of using seed from unsuitable sources has given rise to legislation enforcing seed suppliers to certify the origin of the seed supplied. Some similar certification of seed origin is most desirable in India, especially where seed is supplied from one forest division for use in another one or in a different province.

The stage at present is that we are beginning to realise the importance of hereditary variations. It is now necessary to be on the look out for them, and to record them whenever they are observed to exist. The next stage is for the Silviculturists to test the heredity of the recorded variations, and to follow this up with recommendations about selection of mother trees for seed collection. The third stage is the isolation of strains and races that have the desirable characters, and the final stage is the breeding out of new and improved varieties. India is at present very backward in this matter. It is merely one small item in the field of the silvicultural research officer, while in America and Europe, well staffed institutes have been established for the sole purpose of carrying out tree breeding experiments and building up planting stocks of improved strains.

In the meantime, however, a start has been made. Forest Officers generally are becoming aware of the importance of looking out for improved strains and of taking pains to select seed trees that are free from obviously undesirable characteristics that might be hereditary. More co-operation is required, however, in the matter of recording the existence of definite variations both desirable and undesirable, so that their inheritance can be subsequently tested out. In the course of time, as our knowledge of the subject increases it should be possible substantially to increase the value of the returns we get from the money spent in making plantations.

EFFECT OF STANDARDS ON FIELD CROPS IN TAUNGYA

BY S. HOWARD, CONSERVATOR OF FORESTS, EASTERN CIRCLE, U.P.

Summary.—A frost protecting overwood will reduce the yield from cultivators crops in *taungya* considerably. A crown cover of some 20 per cent will reduce the yield to the cultivator by some 40 to 55 per cent and cultivators are likely to be difficult if not impossible to get on those terms.

Owing to the difficulty of raising some of the valuable species (*sal*, for example) in areas liable to frost, it has been suggested several times that *taungya* crops might be raised under a frost protecting overwood.

In 1936, Mr. Mason started an experiment in the Gorakhpur Division to test the effect of a frost protecting overwood in coppice shoots—a different matter, of course. He divided the area into four parts, the north-west portion of 42 acres with a frost protecting overwood of 15—20 trees per acre of about the 12″—16″ diameter class, the north-east portion of 34 acres clearfelled, the south-west portion of 42 acres clearfelled and the south-east portion, of 35 acres, with a frost protecting overwood of 20—25 trees per acre of the 12″—16″ diameter class. The areas were comparable in climate as far as could be seen.

Later it became evident that the clearfelled north-east portion and the south-east portion with 20—25 standards per acre had insufficient coppiceable material, and he decided to raise an artificial crop under *taungya*, the preliminary cultivators' crop being raised in 1937. Although it is too soon to draw any conclusions on the original object of the experiment, it has given data on the yield of field crops in *taungya*.

I took over the circle at the end of 1937, and knowing of the suggestion in other divisions to raise *taungya* crops under a frost protecting overwood, I decided to measure the yield of field crops from these two areas. Judging by the yield tables, an overwood of 20—25 trees of 12″—16″ diameter per acre represents a crown cover of very roughly 20 per cent.

In March, when the wheat and barley was ripe, it was perfectly obvious to the eye that the crop under the overwood was very inferior to that on the clearfelled area, and this was amply borne out by the grouses of the villagers.

The *rabi* crop was partly wheat and barley mixed, partly pure barley, partly mustard and partly gram. Unfortunately I have no figures of the proportion of each. The average outturn of all together, however, was, in the open 11 maunds 27 seers per acre and under the standards 5 maunds 2 seers per acre.

Thus a crown cover of only some 20 per cent. reduced the yield by over 55 per cent.

Comments on the figures are that the yield for the whole area was taken and it is thought that the villagers were able to conceal some of the yield, fearing that the figures were being collected to inflict some form of tax.

For the *kharif* crop of 1938, therefore, two acres of paddy, one of *tangun* and one of maize were taken in each area and measured up by the forest staff.

Taking the four species together again (but the answer is the same if taken separately) the yield was, in the open 11 maunds 19 seers and under the overwood 6 maunds 28 seers per acre. The rains were poor.

Thus a crown cover of only some 20 per cent. reduced the yield by over 40 per cent.

Even in Gorakhpur, where there is great land hunger, it is very difficult to persuade cultivators to take up areas for such yields, in fact the local staff are doubtful if they could be persuaded again.

Without pretending that one experiment can be conclusive, these figures are an indication that a frost protecting overwood of this intensity (lighter than in many places) will rule out *taungya*.

S. HOWARD,
Conservator of Forests,
Eastern Circle, U.P.

Eastern Circle, U.P.

A DAY AT THE SONEPORE MELA

BY SABU MAJOR.

One of the largest and most important festivals in Bihar is the *Harihar Chhatra,* or the bathing in the Ganges on the occasion of the full moon in November. At the same time the annual fair takes place at Sonepore where horses, cattle and elephants are assembled in large numbers for sale.

From Patna one has to board the ferry steamer at Dighaghat on the Ganges. A tremendous crowd throngs the road; one sees whole families, the females hanging on to one another, so that nobody be lost, in charge of a youth, who is quite conscious of his position as the superior male and orders his flock about like sheep.

The early morning crepitates with the sound of people trying to get rid of their uvulas and apparently without success, for convulsive hawking accompanies us all the way across the river. We are moved by the muse and produce the following tit bit:

Mother dear, what is that sound
Like an exploding goat?
Hush, hush, my child, it's only Ram
Clearing his "morning throat."

Let us be quite clear and state boldly and distinctly that we claim no copyright for the above and that all rights are *not* reserved. We make a present of it to some enterprising purveyor of patent foods. Why not a remedy for *morning throat* in common with *morning yawning* and all the rest of them? You, my dear reader, love the strip advertisement as much as we do. You read these advertisements through and would get full marks in an examination regarding the appropriate remedies for *night starvation, starch heaviness, pink toothbrush,* etc. etc.

Can you not see the strip advertisement headed "He nearly let his son down through *morning throat*"?

In the first picture we see Ram Lal, poor fellow, unsuccessfully attempting to get rid of his uvula and being late at the office in consequence. Ticked off by the boss he goes to see a doctor. The doctor says "a clear case of *morning throat,* I always prescribe Bromax." The next picture shows us our hero taking his Bromax ("a food, not a medicine, and oh, so easy to mix!") and then, completely cured, promoted to the head of the department. The advertisement closes with a happy picture of Ram Lal, junior, failing for his B.A. But we grow affecting, let us proceed.

The crossing to Paleezaghat on the north bank of the river takes about half an hour. Shortly after leaving Dighaghat several Hindu temples and burning ghats are passed. The water is thick with devotees washing their bodies and clothes and filling brass pots with the holy fluid for the day's cooking.

At Paleezaghat there must be many thousands of people, the women in multicoloured saries, crowded together as densely as may be. The water is full of bathers; here, a dust-covered fakir is having, to western minds, a belated wash; there, a woman is going through the rather complicated process of changing a wet sari for a dry one, without exposing her form to the vulgar eye. This difficult feat she performs with complete success.

Ones sees, too, the mystic who sits all day in the water up to his neck. Old crones, bent double with age, come hobbling down the bank. Their dim old eyes light up at the sight of Ganga Mai, and they doubtless pray for that peace after death which the calmly flowing river seems to symbolise.

Itinerant vendors strut up and down carrying trays and poles covered with cheap rubbish, all of which finds a ready sale. Beggars and cripples do a roaring trade, while sweet-vendors, whose wares, we must confess, look attractive, were it not for the clouds of flies, find many customers.

A bumpy journey of a few miles in a train lands us at Sonepore, which possesses the longest railway platform in India; the Station Master told us, the Collector told us, the S.P. told us, and a good many others; let us leave it at that, we believe them. Long as it is, the platform is filled to overflowing with a motley and colourful crowd. Here they are, sitting, lying, sleeping, eating, quarrelling: a buzz of conversation fills the air.

The mela is situated on the west bank of the river Gandak, and is divided up into sections: one devoted to horses, another to cattle, another to elephants and so on. Booths for the sale of every conceivable article have been erected for the fair. The Agricultural Department has a show while a propaganda lorry is very busy. This contraption is rather startling: a loud-speaker delivers sweet sounds of music which has the effect of drawing a large crowd. Suddenly a silky voice informs the assembled multitude that strong drink does considerable harm to their insides. Before the crowd can disperse to digest this piece of news they are again attracted by music. One gentleman with whom we had conversation wondered whether a glass of toddy poured into the loud-speaker would do harm to *its* inside. He seemed to think that a positive result in this experiment would greatly benefit the community—but then, he, like ourself, is a vandal.

The elephants, which principally engage our attention, are to be found on the bank of the Gandak river. The railway embankment passes through the camp and the approach and passing of each train is heralded with trumpetting, squeaking, rumbling and other elephantine noises.

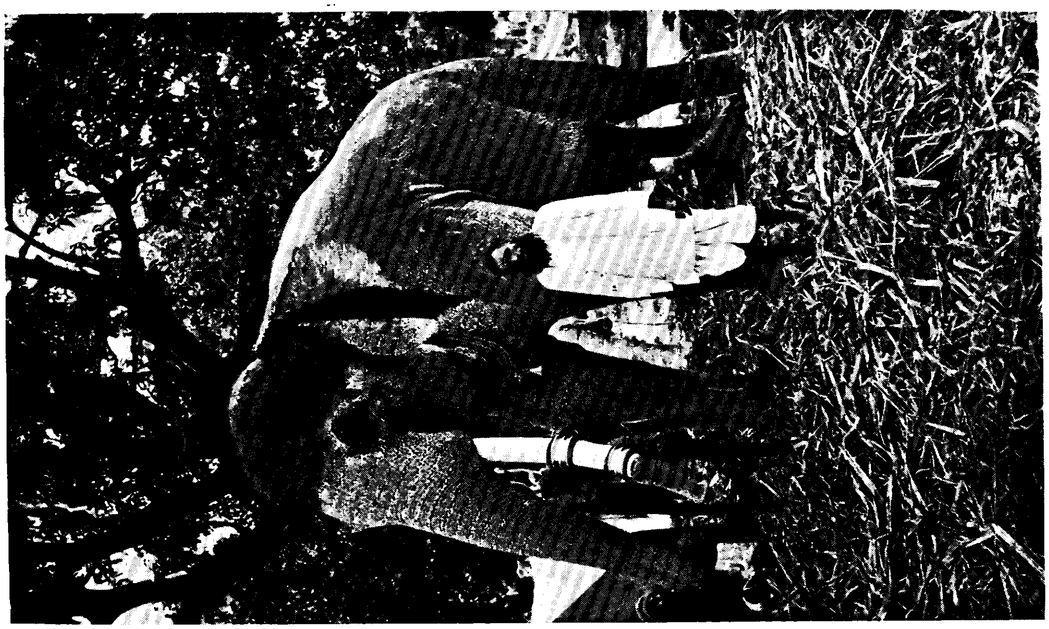
Here they are, hundreds of them, from monstrous tuskers to little calves scarcely a year old, all displayed, in the owners' opinion, to the best advantage. Their bodies are covered with weird designs in coloured chalks and the tops of their heads burnished with oil.

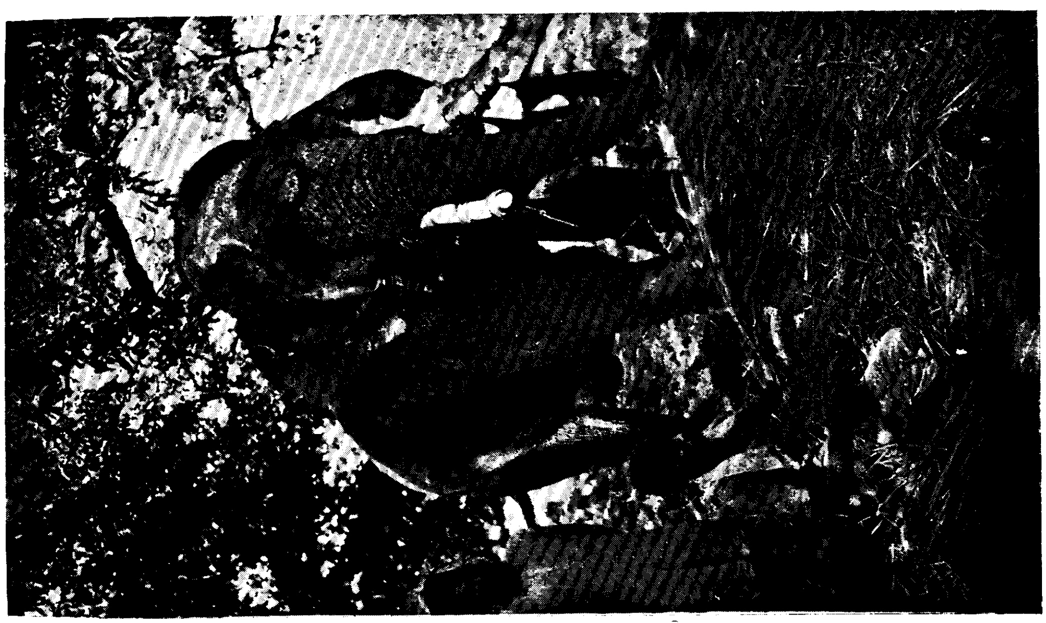
One wonders what the elephant thinks of it all, especially the magnificent tusker with the delineation of a flower pot, complete with unknown plant, executed in red and yellow chalk on his hind quarters.

Paleezaghat: part of the large crowd which had gathered for the Harihar Chhatra.

The finest animal in the fair: was sold for over Rs. 9,000/-.

Elephantine fashions at Sonepore.





Fine tuskers at the fair: the tusks are decorated with brass rings from which are suspended coloured streamers.

These designs are often cunningly used to mask old or new scars or to draw attention away from a swelling. Where the milkiness of the cornea betrays incipient blindness the side of the head all round the eye is painted white.

The head and backs of the larger elephants are covered with scarlet drapery which has the effect of making a noble animal look ridiculous, but is useful for concealing sore backs and half-healed wounds.

An elephant's nails are all important, eighteen is the correct number and an elephant which possesses less is considered unlucky. On the other hand (or should it be foot?) the possession of more is considered extremely lucky. We did not see any cases of faked nails but this trick has been practised on other occasions. Cracked and broken nails are filled with hard fat and polished.

The paring down of tusks is a trick designed to make an elephant look younger than it really is, but any competent observer would not be taken in for an instant.

The stands upon which the animals are displayed slope from the front to the hind feet. This is presumably done to give an appearance of height but it must be trying for the beasts themselves. At the elephant's head sits an attendant whose duty it is to feed it all day long. Sugarcane, plantain trees, rice (straw and ear together), and even young thatch grass are supplied in large quantities. In addition they are given small quantities of cooked rice, gur and paddy.

If one should show interest in any particular elephant a small crowd collects and points out the desirable features in the animal. Such a crowd is often helpful as they will show obscure defects in the property of their rivals.

The buying of an elephant is bargaining on a grand scale. The owner demands a ridiculously high price to which the buyer counters with a low bid equally ridiculous. This, apparently, is all that is done in one day. The following and subsequent days the buyer raises his initial bid little by little and the seller reduces his gradually until finally they agree upon a price.

The bird market is worthy of a visit. Here are to be seen budgerigars, mynahs, cockatoos, munias and many other varieties. Some can talk well and others can swear, and quite efficiently too. One ancient grey cockatoo with a glittering yellow eye and a red tail attracts our attention. When a sepulchral "U dam" issues from a face upon which no known emotion is depicted, we are interested. "* * * ! ! ! !" says the bird: we are appalled and pass on rapidly and not even the vendor's "this bird good talker" can effect a sale.

We are tired of the noise, the dirt, the importunities of beggars, the blandishments of snake-charmers, fortune-tellers and conjurers, so, in company with thousands of others, we wend our way slowly to the longest platform in India and back to Patna and peace.

TIMBER PRICE LIST, JANUARY-FEBRUARY 1939

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 48-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 0-15-7 to 1-3-3 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-8-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-8-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-12-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 3-10-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 1-3-0 per c.ft.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Rs. 0-6-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-3-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. Sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 52-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Rs. 1-4-0 to 1-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-12-0 to 1-4-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-0 to 2-5-0 per c.ft.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. Sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 0-8-6 to 1-4-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 2-6-9 to 6-1-3 per c.ft. in round.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-3 to 5-4-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 0-15-8 to 2-0-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 33-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per scantling.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-12-10 to 1-6-0 per c.ft. in round.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 0-14-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 0-15-2 to 1-9-7 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 2-0-0 to 2-8-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-8-0 to 2-10-0 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

STATEMENT OF WILD ANIMALS SHOT IN SOME OF THE INDIAN

All-India serial number.	Species.	Ajmer-Merwara.	Bengal.	Bihar.	Bombay.	Burma.
1a	Tiger ..	..	31	5	19	57
1b	Tigress ..	..	22	3	15	..
2	Leopard or panther ..	..	21	4	67	51
3	Wild cats (species to be given if known)	..	16 (includes 6 civets)	..	1	..
4	Lynx ..	..	..	..	..	..
5	Hunting leopard or cheetah	..	..	..	..	..
6	Hyaena ..	..	..	..	1	..
7	Wolf ..	..	..	..	..	..
8	Wild dog ..	..	..	..	4	53
9	Martens ..	..	..	..	..	..
10	Ratel ..	..	..	..	..	..
11	Brown bear ..	..	..	..	..	..
12	Himalayan black bear ..	..	3	..	..	..
13	Malayan bear ..	..	..	..	..	..
14	Sloth bear ..	..	2	4	12	101 (bear)
15	Wild elephant ..	..	13	..	19	315
16	Rhinoceros (species to be given).	..	..	..	21	27
17	Gaur or bison ..	..	..	..	..	..
18	Gayal or mithan ..	..	..	..	..	35 (saing)
19	Banting or tsine ..	..	..	..	..	..
20	Wild buffalo ..	..	..	..	..	..
21	Urial or sharpu ..	..	..	..	..	..
22	Bharal or blue sheep ..	..	..	..	..	..
23	Ibex ..	..	..	..	..	..
24	Markhor ..	..	..	..	..	..

PROVINCES, INDIAN STATES, AND BURMA DURING 1936-37

C. P.	Coorg.	Madras.	Orissa.	Punjab.	U. P.	Jammu and Kashmir State.	Bastar State.
117	6	2	13	3	69	..	9
..	..	..	2	..	39	..	..
88	11	13	12	11	90	28	36
..	..	..	3	..	16	..	..
..	..	..	..	..	..	4	..
..	34	..	..	..	..	..	..
13	..	1	1	..	23	..	..
1	..	..	..	..	..	55	1
19	4	3	1	..	8	..	15
..	..	..	..	..	15	..	..
..	..	..	..	..	..	..	..
..	..	..	..	1	..	12 (red bear)	..
..	..	..	..	..	20	31	..
..	..	..	..	..	..	..	..
35	..	4	4	..	30	..	18 (bear)
..	..	1	2	..	..	..	..
14	..	..	..	..	..	..	..
..	..	9	3	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	9
..	..	..	..	24	..	16 (sharpu)	..
..	..	..	..	2	..	10 (burhal)	..
..	..	..	..	1	..	30	..
..	..	..	..	..	..	17	..

Statement of Wild Animals shot in some of the

All-India serial number.	Species.	Ajmer-Merwara.	Bengal.	Bihar.	Bombay.	Burma.
25	Tahr ..	..	..	..	..	..
26	Nilgiri wild goat or Nilgiri ibex.	..	..	..	..	..
27	Serow or Himalayan goat-antelope.	..	..	..	..	1
28	Goral ..	..	6	..	..	1
29	Nilgai or blue bull ..	1	..	1	36	..
30	Four-horned antelope ..	..	..	..	3	..
31	Black buck ..	..	..	..	..	..
32	Indian gazelle or chinkara	..	..	..	5	..
33	Barking deer or kakar ..	..	119	3	3	211
34	Kashmir stag or Hangul	..	..	..	..	..
35	Swamp deer or gond or barasingha.	..	..	..	..	..
36	Brow-antlered deer or thamin.	..	..	..	..	18
37	Sambar ..	..	15	10	14	187
38	Cheetal, or spotted deer or axis deer.	..	223	9	18	..
39	Hog deer or para ..	..	12	..	..	53
40	Musk-deer ..	..	..	..	..	..
41	Mouse-deer ..	..	..	..	..	..
42	Pangolin ..	..	..	..	..	..
43	Crocodile (muggar) ..	..	48	..	..	..
44	Gharial ..	..	..	..	..	..
45	Python ..	..	92	..	..	..
46	Others (species to be given).	8 (pig)	296 (wild pig 287) (hares .. 6) (porcupine 3)	3 (hare 1) (jackals 2)	509 (wild pig)	195 (pig)

Indian Provinces, Indian States, and Burma during 1936-37—(*concld.*)

C. P.	Coorg.	Madras.	Orissa.	Punjab.	U. P.	Jammu and Kashmir State.	Bastar State.
..	..	..	..	..	2	17 (thar)	..
..	..	..	..	..	..		
..	..	..	..	..	1	6 (Tibetan antelope)	..
..	..	..	..	1	40	13 (gural)	..
90	..	..	2	..	61	..	12 (nilgai 6) (blue bull 6)
..	..	..	..	..	1	..	..
116 (includes species of items Nos. 31—33)	..	4	..	1	25	..	..
..	..	..	..	..	2	3 (Tibetan gazelle)	..
..	..	..	3	9	62	..	..
..	..	..	..	..	..	..	..
3	..	..	..	..	16	11	..
..	..	..	..	..	..	..	..
116	..	5	4	1	89	..	20
86	..	3	4	..	181	..	26
..	..	..	..	..	12	..	..
..	..	..	..	..	1	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
5	..	1	3	..	5	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	7	..	..
621 (wild pig)	..	2 (pig)	6 (wild pig)	113 (pig)	916 (otter, porcupine, pig, etc.)	8 (Ovis ammon 6) (otters 2)	42* *(kotri 28) (hundar 1) (boar 13)

REVIEWS

MANUAL OF INDIAN SILVICULTURE

BY CHAMPION AND TREVOR.

(Oxford University Press, Indian Branch, 1938. *Pp. XIV* + 374, *Diagrams VIII, Maps* 2, *Plates* 33. *Price Rs.* 20.)

The production of this new *Manual of Indian Silviculture* is to be warmly welcomed. It is now over 30 years since the old *Concise Manual of Silviculture,* based largely on European practice, was compiled for students in India, and that little book, good in its day, has long been obsolete and out of print. During the last twenty years in particular, Silviculture in India has made extremely great progress, and although many excellent Forest Records and other publications have appeared, for a good time there has been felt a

very great need for the compilation of a book summarising our Silvicultural knowledge and practice to date.

The new manual has been produced so as to be available for students of the new Indian Forest College, opened in 1938 for the training of men for the Superior Forest Services. It is, however, by no means just a text-book for students. It has been written as much for the forest officer as for the student, and there is probably no one, of however much experience, who will fail to find much valuable and interesting information within its pages.

The book is divided into two parts: Part I, General Silviculture, by H. G. Champion, and Part II, Silvicultural Systems, by Sir Gerald Trevor. Having been Silviculturist at the Forest Research Institute, Dehra Dun, for some ten years, during which time he not only toured extensively over all parts of India, but also over many other parts of the world, Champion has been constantly in touch with all branches of silvicultural progress, and with his erudite knowledge of connected sciences, he was uniquely qualified to write the first part. The qualifications of Sir Gerald Trevor, lately Inspector-General of Forests and President of the Forest Research Institute, his wide experience, and his great reputation as a practical Forest Officer need no further mention.

Part I deals first with the foundations of Silviculture, under the heads Locality Factors, Growth and Form of Trees and Crops, and Tree and Crop Physiology. While this necessarily includes the enunciation of many general principles, the whole has been very definitely written from the Indian standpoint, and copious examples are quoted throughout from Indian forests and of Indian species. Parts of the section on Physiology are more purely botanical than silvicultural and have necessarily had to be dealt with very briefly and incompletely, but they have been included in recognition of the fact that Silviculture demands a knowledge of plant physiology.

Forest Composition and Distribution are next dealt with, and include a very useful section on ecology under the head Colonization and Succession, and a summary of the chief forest types of India, based on Champion's *Preliminary Survey of the Forest Types of India and Burma*. The rest of Part I deals with the more practical subjects of Natural and Artificial Regeneration, Afforestation and Tending. The chapter on Artificial Regeneration is the longest

in the book and is a reflection on the importance this now occupies in practical Indian forestry.

Part I as a whole is an excellent and scholarly summary of our present silvicultural knowledge and practice, and its value is enhanced by the copious References to Literature, classified under General and Special References, at the end of each chapter. Tabular statements have been introduced wherever necessary, but the general style is descriptive and is essentially readable, although the student, with his great desire to marshall and number his facts, might possibly wish for further classification under certain heads. Thus there is no classified list of the relative merits of even-aged and uneven-aged crops, or of the advantages and disadvantages of pure and mixed crops, although pure and mixed crops are described under Forest Composition and past practice and present tendencies are discussed under Artificial Regeneration.

Part II on Silvicultural Systems occupies slightly less than one quarter of the book, which would appear somewhat small considering the variety of Indian forest conditions and methods of management. The arrangement follows Troup's *Silvicultural Systems,* which deals with European practice, and as frequent reference is made to that book, the general descriptions of the various systems are reduced to a minimum. This part therefore is very definitely not a text book on Silvicultural Systems in general, but is a clear and concise account of the application of the various systems to Indian conditions, and of the various modifications that have been worked out in this country. A little more detail might perhaps have been given, and one misses the References to Literature at the ends of the chapters. But the descriptions given are sufficiently complete to explain clearly the general principles of each system, and a few references have been given on the pages where they occur; further, if full references had been given, they would have had to include practically all the working plans in India.

The printing and general get-up of the book are good; the numerous plates and diagrams have been well selected and well reproduced, and there is a very good index. The two maps, one of the Average Rainfall of India at the beginning of the book, and the other of the Distribution of Climatic Types at the end of the book are a distinct asset. Both these maps and the Soil Moisture, Rainfall

and Temperature diagram open out clear of the book, a useful feature, and it is a pity that the diagramatic chart of Thinning Methods was not made to open out in the same way. The Rainfall map would have been a little better if more distinctive shades of blue had been adopted for the four classes from 4″ to 40″, as in the map in Vol. I of Troup's *Silviculture of Indian Trees,* and a slight reduction of the bold type filling the main title page, might also have been a minor improvement. Typographical mistakes are extremely few. *Lagerstroemia parvifolia* on p. 148 presumably stands for *L. parviflora,* and the reference, two-thirds way down p. 118 to p. 57, should apparently be to p. 37.

To sum up, the book as a whole is definitely good. The price at Rs. 20 is perhaps a little high, but this is really not excessive in view of the nature of the book and as modern books go. The manual should be in the hands of every forest officer, and might well be provided in every range office for the benefit of English knowing subordinates.

E. C. M.

EXTRACTS

EROSION AND FLOODS

PROBLEMS OF SOIL AND WATER CONSERVATION IN THE UNITED PROVINCES

By E. A. Smythies, I.F.S.

Chief Conservator of Forests, United Provinces.

Now that the Central Board of Irrigation has realized the dangers that threaten the Gangetic basin, which the Forest Department in the Punjab and United Provinces have been emphasizing for years, a brief survey of the general position may be of interest, which will, it is hoped, indicate the danger which is slowly but inevitably developing and threatening the prosperity not only of the United Provinces but also of the adjoining provinces of the Punjab and Bihar. The Gangetic watershed, in fact, has all the physical conditions present that must unleash powers of destruction, denudation and desiccation against which man is helpless, if the only real defence *i.e.*, natural vegetation—is once destroyed.

These conditions are:

(*i*) A monsoon climate, with a long hot dry period and a fierce short rains period, causing a "tension belt" for natural vegetation.

(*ii*) A tremendous range of high mountains in the upper reaches of the main rivers, from which increasingly destructive floods and decreasing water-supplies after the monsoon are inevitable as the protective vegetation is destroyed or reduced.

(*iii*) A densely populated and easily denuded alluvial plain, from which the natural protective vegetation has practically disappeared.

(*iv*) An enormous domestic animal population, with intense and universal overgrazing of all waste and uncultivated land, against which the protective natural vegetation has no chance to survive or function. Although the threat of erosion to human prosperity (and even existence) is now clearly recognized in all five continents of the globe, I doubt if there is any area in the world where the danger is so great as in the Gangetic basin, where so little is being done to meet the danger, and where a population of 100 million human beings is liable to be affected.

EXAMPLES OF EROSION

Mr. Richardson at the Central Board of Irrigation gave concrete examples of erosion resulting from the destruction of natural vegetation. The Imperial Bureau of Soil Science has recently issued an excellent summary (Technical Communication No. 36) of the problem in more than thirty countries, scattered over the five continents, with India holding a prominent place. The Hoshiarpur foothills are mentioned as a classic example proving how the destruction of vegetation in the hills (chiefly by overgrazing) will destroy cultivation in the plains. The area of the *chos* (boulder and sandy torrent beds) increased from 48,000 acres in 1852 to 94,000 acres in 1897, *i.e.* doubled in 45 years. To-day it is a horrible desert covering 450,000 acres (*i.e.* quintupled in the next 40 years; 940 villages with over 70,000 acres of fertile fields have been overwhelmed and the headworks of the canals seriously endangered. By contrast, there is an almost exact parallel in the adjoining district of Saharanpur. Here the unstable Siwaliks have been under the strict protection of the Forest Department for 50 years, with careful fire-protection and practically no grazing. The increase of area of the *chos* has been negligible, and the danger to the Ganges and Jumna canals has very greatly decreased.

The gully erosion in the Jumna-Chambal tract is also mentioned as another classic example of erosion following destruction of vegetation (again due chiefly to overgrazing). An article in "Public Information" of June 1938 had the following note: "In the Jumna-Chambal basin, for example, between a quarter and half million acres of land have had 20 to 40 feet depth of soil eroded. *This represents the loss of a perpetual stream of soil, never stopping for an instant day or night, removing over* 12 *cusecs or half a ton per second for the past* 1,000 *years.*" After 25 years of experiment the Forest Department have conclusively proved that this erosion can be enormously reduced, if not entirely checked, simply by control of grazing which enables the natural vegetation (and particularly excellent fodder grasses) to re-appear remarkably quickly, *i.e.*, within a year or two. Thus not only is the erosion reduced, but simultaneously fodder production is greatly increased, a double benefit in a province where 40 million domestic animals have too little to eat.

LOCAL PROOF

The *Statesman* in a recent leader, stated that "local proofs cannot be given until the damage is so serious and widespread as to be difficult of remedy." The two examples given above afford very definite local proof of this, and although the damage already done cannot be rectified, it is still possible by large scale and concerted action to protect the natural vegetation from overgrazing and other abuses, to prevent further extension of the damage which is bound to continue if adequate action is not taken. And "adequate action" does not imply expensive engineering works or afforestation and tree planting. A good growth of grasses and shrubs and plants that spring up naturally will give the necessary protection. Nature, if not abused, will do all that is required.

The evil effects of denudation reach areas far from the source of the evil. Thus the plainsman is affected by the action of the Pahari; Bihar is dependent on what is happening in the distant Himalayas and the upper Gangetic basin, since the silt-choked rivers cannot carry off the increased water during periods of heavy rain, and flood the countryside; the elaborate and expensive engineering works of the Tennessee Valley Project in the United States of America and the 8-crore Uhl Valley Project in the Punjab are seriously endangered by the absence of adequate protective vegetation in the distant upper reaches. The disappearance of the natural vegetation of the prairies has resulted in the tremendous problem of the "Dust Bowl" of the United States of America and the desiccation of the prairie provinces of Canada.

Desert conditions, resulting from disforestation, have now for centuries covered the North African wheat belt that was the main granary of ancient Rome. The conversion of the once fertile Tigris Valley (in the days of Babylon), into a desert has been ascribed to creeping desiccation and silting up of rivers following the destruction of forests and vegetation in the distant hills. The devastating floods of the Yellow and Yangtze rivers of China are directly traceable to the disforested hills in the upper catchments.

A CLEAR WARNING

These ancient and modern examples can be multiplied indefinitely, and give a clear warning that it would be fatal to disregard.

The Punjab Government are, it is believed, taking up the matter seriously, and from April next propose to appoint a Senior officer as Director of Anti-erosion, with several gazetted officers and subordinate staff under him, to tackle certain areas chiefly in the foothills.

In the United Provinces, the foothill zone is, fortunately already well protected, as the whole belt from the Jumna to the Sarda (except north of Dehra Dun) is reserved forest, under the Forest Department. But in the higher hills of Kumaun there are extensive areas of forest, totalling 2,000 sq. miles, with no protective staff for the past 15 years, which in the accessible parts near villages are being rapidly destroyed. Mr. Ford Robertson, in the last few pages of his excellent little book "Our Forests" has given clear and emphatic warning of the inevitable results of such destruction, not only to the hill people but to the distant plains people as well.

East of the Sarda river lies 40 or 50 thousand square miles of mountains in Nepal, the catchment area of many rivers, such as the Sarda, Gogra, Rapti, Gandak, Kosi, etc., and therefore of supreme importance (for flood control) to the United Provinces and Bihar Governments and people.

WASTE LANDS

In the Gangetic plain, within the boundaries of the United Provinces, are found 12,000 to 15,000 square miles of *usar, bhur,* ravines and other uncultivated waste lands, all of which have one constant feature, *i.e.* overgrazing and destruction of natural vegetation, and therefore liable to erosion and denudation. The United Provinces Government are at present exploring the possibilities of checking erosion and improving fodder on these extensive areas of mutilated wastes, which tend to eat into fertile cultivation and to overburden the rivers with silt.

It is not known what action the Bihar Government are taking, or in fact what action they can take, since the chief sources of danger of floods in Bihar lie in the distant Himalayas and Upper Gangetic plains and Central India, so that the floods in Bihar are very largely traceable to the actions of others. Unfortunate Bihar!

The chief source of danger from erosion and floods that threatens the future prosperity of Northern India can now be

summarised. It is *the destruction of natural vegetation* in 3 main zones:

(1) The Himalayan zone of the Punjab, Kumaun and Nepal.

(2) The drainage basin of the Ganges tributaries on the south-bank, from Rajputana and the Central India plateau and hills.

(3) The uncultivated lands in the Gangetic plain itself, leading to gulley and sheet erosion and too rapid run-off.

IMMEDIATE ACTION

The *Statesman,* in a leader in its edition of November 25th, has drawn attention to the serious nature of the problem, and the Central Board of Irrigation has unanimously called for immediate action on a far larger scale than has hitherto been attempted. In this brief article, an attempt has been made to show the gigantic nature of the problem and the gigantic issues involved—not less than the future prosperity of crores of human beings,—and it has been shown that the problem depends on several provinces, a number of Indian States, and even a Foreign Power. Action by any individual province cannot solve the problem; there should be a branch of a Department in the Central Government to deal with erosion generally, capable of convening a conference of all interested parties, co-ordinating and encouraging activities, disseminating knowledge, and so on. But if no action is taken, and destruction is allowed to continue unchecked, the writing on the wall that gave warning of coming disaster to an earlier dynasty and race, will be equally applicable to India and the people of the Gangetic Basin.—*The Statesman, December* 12, 1938.

A CHEAP METHOD OF WEATHER PROOFING KACHA WALLS

To the soil used for making *gara,* add sodium carbonate at the rate of 20 lbs. for every 100 cubic feet.

The *gara* is then made by puddling and the addition of wheat straw.

Just before plastering add cement at the rate of 5% by weight of the original soil.

Apply the mixture as a plaster.

This mixture has been prepared by the Punjab Irrigation Research Institute and tests have shown that it is not only impermeable but does not erode under the heaviest rains that we are likely to experience in the Punjab.

(*News Item supplied by the Commissioner, Rural Reconstruction, Punjab, Lahore.*)

ORANGE OIL

Oranges grow in abundance in the plains of the Punjab, and their production is showing a steady increase. According to the figures supplied by the Marketing Officer of the Department of Agriculture the production, during the year 1934-35, of two principal varieties of oranges, namely, malta and sangtara was 524,256 and 7,11,271 maunds respectively. Hitherto these oranges were mostly consumed in eating, but recently the production of orange squashes, etc., has been started on a small scale in the Punjab. The orange fruit is known to yield some other useful products as well, but these have not so far been extracted from it. The most important of them are orange oil and pectin. Orange oil finds use in confectionery for flavouring as well as in perfumery and medicine. Pectin is used for the manufacture of food jellies. Local and foreign markets exist for both these products. With a view to study the possibilities of their production from the Punjab fruits, work was undertaken by the Department of Industries at its Industrial Research Laboratory in Shahdara. It has been found that the Punjab orange generally yields good quality orange oil and pectin. The preparation of pectin may be a little difficult matter, but orange oil from the peels can be extracted easily by the hand sponge process as used in Italy, which consists of pressing the peels between the two fingers of the hand and receiving the oil in a sponge from which it is later on removed. This method can be easily followed in Punjab homes by women-folk. The oil can also be recovered from peels by steam distillation in an ordinary distillation still. One and a half maunds of fresh peels yield, by the latter method, about one pound of oil at a total cost of Rs. 3/12/-. The local price of the oil is quoted at Rs. 5/- per lb. Samples of the oil prepared in the Industrial Research Laboratory were sent to the various local dealers and consumers, all of whom have reported favourably about its quality. The Industry is particularly suitable for firms which are engaged in the preparation of orange squashes—one such manufacturer at Amritsar has already started the extraction of orange oil. Last season he prepared about 50 lbs. of oil, the whole of which was consumed locally in the manufacture of soda water, fruit, and other essences. In those areas of the province, specially the colonies, where orange peels can be collected easily and cheaply, the production of orange oil will be found to be a profitable industry.

(News Item supplied by the Commissioner,
Rural Reconstruction, Punjab, Lahore.)

The following information is taken from the accounts relating to the *Seaborne Trade and Navigation of British India* for December 1938 :

IMPORTS

ARTICLES	MONTH OF DECEMBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
Siam ..	55	79	22	6,092	12,710	3,565
French Indo-China	..	104	455	..	12,515	53,536
Burma ..	..	14,154	14,044	..	18,75,460	18,11,992
Java ..	501	44	..	51,205	7,595	..
Other countries ..	..	93	..	..	10,547	..
Total ..	556	14,474	14,521	57,297	19,18,827	18,69,083
Other than Teak—						
Softwoods ..	654	2,308	2,148	37,269	1 69,553	1 74,845
Matchwoods ..	916	717	432	57,855	49,354	25,824
Unspecified (value)	..	..	..	21,169	2,80,493	3,11,631
Firewood ..	28	36	..	420	540	..
Sandalwood ..	14	10	38	6,744	1,489	7,054
Total value ..	..	..	..	1,23,457	5,01,429	5,19,354
Total value of Wood and Timber ..	..	..	..	1,80,754	24,20,256	23,88,437
Manufactures of Wood and Timber—						
Furniture and Cabinet-ware ..		No data			No data	
Sleepers of wood ..	..	4	29	..	511	2,397
Plywood ..	238	383	641	61,085	94,881	1,29,572
Other manufactures of wood (value) ..	..	..	..	1,55,829	1,00,511	1,03,251
Total value of Manufactures of Wood and Timber other than Furniture and Cabinetware ..	..	..	..	2,16,914	1,95,903	2,35,220
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	21,104	20,070	20,827	1,42,395	1,36,164	1,52,041

EXPORTS

ARTICLES	MONTH OF DECEMBER					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	4,182	..	..	8,64,921	..	..
,, Germany ..	691	..	..	1 83,756	..	..
,, Iraq ..	36	48	16	6,262	3,160	1,368
,, Ceylon ..	205	..	1	21,867	109	..
,, Union of South Africa ..	1,009	..	..	2,17,370	..	..
,, Portuguese East Africa ..	287	..	..	49,965	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	989	144	119	2,12,960	41,657	36,855
Total ..	7,399	192	136	15,57,101	44,817	38,332
Teak keys (tons) ..	351	..	..	51,267	..	..
Hardwoods other than teak ..	30	..	..	3,000	..	..
Unspecified (value)	..	..	..	1,69,496	90,545	52,266
Firewood ..	..	1	..	..	8	..
Total value ..	..	..	..	2,23,763	90,553	52,266
Sandalwood—						
To United Kingdom	12	..	..	15,727	..	130
,, Japan ..	2	2	5	1,600	2,500	6,000
,, United States of America ..	15	27	33	19,392	29,195	26,910
,, Other countries	..	..	..	..	..	..
Total ..	29	29	38	36,719	31,695	33,040
Total value of Wood and Timber ..	..	..	..	18,17,583	1,67,065	1,23,638
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	18,691	34,246	1,14,319
Other Products of Wood and Timber		No data			No data	

INDIAN FORESTER

APRIL 1939

CELLULOSE AND LIGNIN

BY M. P. BHARGAVA

Cellulose is playing a role of ever increasing importance in modern life. In 1937, an exhibition was organised in Germany to show that practically all the necessities of modern civilisation, as well as many of its amenities, could be supplied directly or indirectly through wood pulp, *e.g.*, the multitudinous varieties of papers and boards, rayon, clothes, furniture, fancy articles, foodstuff, explosives, power alcohol, sugars, constructional materials, plastics and so on. The growth and development of the various industries has been rendered possible as a result of intensive scientific exploration in the laboratory of the wood aggregate and its sub-microscopic subdivisions. An account of how the scientific concepts of the wood aggregate and of the structure and composition of cellulose and lignin—the two main components of wood—have helped in the development of the cellulose industries and in effecting improvements in the methods of seasoning and preserving timber is given in a fascinating article, "Exploring the labyrinth of cellulose and lignin," by E. C. Sherrard in the September 1938 issue of the *Journal of Forestry*, published by the Society of American Foresters. The recognition, that lignin forms an enveloping matrix about the fibres, has led to the development of the "semi-chemical" pulping processes, around which have grown a number of paper and board industries. Structural analysis of the cellulose fibre has led to rational improvements in the qualities of papers and in the production of rayon from wood pulp. Increasing knowledge of the structure of wood in which the diffusion of moisture takes place has helped in setting up efficient drying conditions and in evolving a new method of chemical seasoning of timbers. A new "substitution" method of impregnating wood with synthetic resins has been developed, which serves to reduce

considerably the swelling and shrinkage of wooden articles such as athletic goods, musical instruments, shoe-lasts, etc. Intimate knowledge of the minute structure of wood has also been found of immense help in other related fields of wood research, *viz.*, preservation treatment, painting, gluing, decay investigation, etc.

While development of industries, for the manufacture of the various products mentioned above, has been based on the utilisation of only one important component of wood, *viz.*, cellulose, the other important component, lignin, was until recently regarded as a mere slag or dross and was run to waste from the pulp mills at the rate of a million-and-a-half tons a year, to pollute rivers and perplex the public conservation authorities. Recent researches, however, have thrown light on the structure and character of the lignin complex in the wood and have evolved methods to segregate it free from all carbohydrate products. A new vista into an economic future for lignin is thus being opened up. A limited use for lignin is already found in the manufacture of linoleum adhesives, in tanning operations and as road binders. New products are also being produced from lignin which promise to have important industrial applications, *e.g.*, for use in the manufacture of motor-car batteries, preservatives against wood-destroying fungi, plastics, especially sheet materials, panels, wall-boards and moulded products and so on. Joint investigations on cellulose and lignin will thus enable utilisation of the inner wealth of wood for the development of a multitude of industries.

In India, the manufacture of paper and boards, which is fast developing, will, of course, utilise part of the enormous potential supplies of cellulose, existing in the rich forest wealth of the country. The establishment of other important industries, based on cellulose, and the economic utilisation of the vast quantities of the by-product lignin will, no doubt, follow as a result of intensive research which, it is hoped, may be organised in the near future.

THE MONTANE EVERGREEN FOREST, BISALE REGION

By Kadambi Krishnaswamy, Assistant Conservator of Forests, Mysore

Abstract.—The Bisale State Forest, with an area of about 15 square miles occupies the south-western extremity of the Western Ghats of Mysore. The country is hilly, with altitude ranging from 450 to 3,521 feet. It is covered by evergreen forest. Warmth and moisture determine the nature of growth. Most of the rain falls in the south west monsoon. The humidity, especially during the rainy season, is very high and even in the other seasons, it approaches the point of saturation under the forest roof during the early hours of the morning.

Although the forest is never bare of leaves, the growth and reproductive activities are confined to a short time in the year. During the rainy season there is little or no growth. The main growing season is after the rains and before the dry season. The flowering season corresponds to the driest season of the year—January to March. The fruits ripen generally in May and June.

Three principal zones of growth are: the semi-evergreen passing on to the deciduous under 800 feet; the evergreen zone from 800 to 2,500 feet; and the bare, grassy hill-tops, over 2,500 feet. The transition from the deciduous through the semi-evergreen to the typically evergreen is gradual but that from the evergreen to the bare hill-tops is abrupt.

The evergreen flora shows two distinct associations of tree species, the Dipterocarpus-Vateria type and the Vateria-Elaeocarpus type. The latter is an edaphic variant on the former. The evergreen type is described in detail, along with its storeyed vegetation. The deciduous type has been mentioned briefly. The ecological factors affecting tree growth in these forests and leading to the formation of the climax type of vegetation have been discussed.

Physical Features of the Region.—The forest land dealt with occupies the south-western extremity of the Western Ghats of Mysore. It covers, in a roughly triangular form, about fifteen square miles of land and adjoins the Kombar and Subrahmanya reserves of South Kanara to the West, the Kadamakal reserve of Coorg to the South and the Kagineri State Forest to the North.

The country is mountainous. The highest point lies to the extreme south-east of the area with an elevation of 3,521 feet, while the lowest lies to the extreme south-west, with about 450 feet. The underlying rock is granitic gneiss. The soil is lateritic and of the high level type, porous and rich in oxides of iron. The drainage is good.

Climatology of the Forest Region.—The forest, here chiefly described, belongs to the type which ecologists call "evergreen." The shedding of leaves is not conspicuous in any part of the year. These forests are also classed by some under "Tropical Rain Forests." The name indicates that, in general, the two growth factors

"warmth" and "moisture" determine the nature of growth. The monsoon winds from the Arabian Sea, which come saturated with water vapour, cool on ascending the steep hill slopes and call forth, during the rainy season, almost incessant precipitations. In this season, water trickles down the leaf surfaces of trees almost constantly and the humidity of the atmosphere remains during the greater part of the day and night almost at the point of saturation. In summer the heat causes a warm fog to ascend, during daytime, from the perennial sources of water into the leaf canopy, which stands at least a hundred feet high, and, during the cool hours of the early morning, dewy precipitations are an almost daily event.

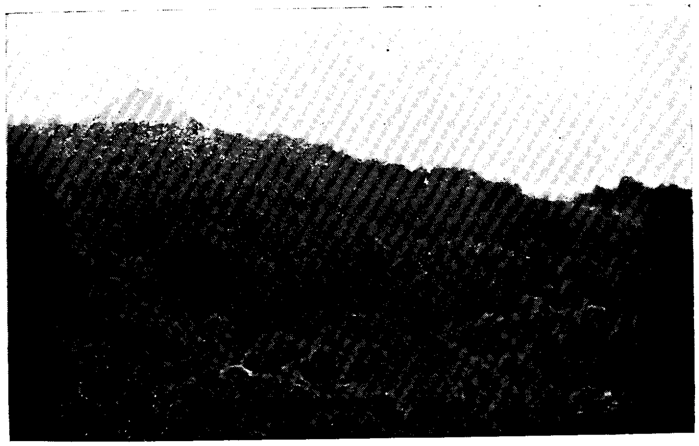
The following table shows the average rainfall of two recording stations near the forest region. The figures are extracted from the rainfall records of the Mysore Meteorological Department:

PLACE.	AVERAGE RAINFALL OF TWENTY YEARS, IN INCHES.												
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Total for the year.
Marnhalli ..	0·21	0·05	0·33	1·59	4·59	37·88	84·58	51·78	14·94	8·12	3·49	0·53	208·08
Hanabal ..	0·19	0·16	0·45	2·07	3·85	27·04	51·31	23·75	8·33	7·37	2·91	0·65	128·08

Temperature.—Unfortunately, there are no dependable records of temperature anywhere close to the forest region. The nearest station where such records exist is at Hassan. The following are the details of the temperature at that place:

DETAILS OF TEMPERATURE	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
Monthly mean maximum temp. (Fahrenheit).	82·6	86·8	91·5	92·6	88·8	80·5	77·5	78·6	80·8	81·8	80·3	80·2
Monthly absolute maximum temp. for 1936.	88·3	90·2	94·7	97·6	97·8	88·1	82·1	83·4	88·9	88·9	84·4	87·2
Monthly mean minimum temp.	56·3	58·7	62·8	66·8	67·2	66·7	65·2	64·7	64·4	64·3	60·9	56·5
Monthly absolute minimum temp. for 1936.	55·5	55·9	59·3	62·1	63·7	61·4	64·7	60·9	65·1	60·2	53·1	53·5

Fig. 1.



General view of the evergreen forest from an opposite elevated point. The dome shaped crowns along the sky line are **Dipterocarpus indicus.**

Fig. 3.

Storeys of vegetation are recognisable at the edge of a forest clearing. The tallest trees in the picture are **Kingiodendron pinnatum (Hardwickia pinnata).**

Fig. 4.

The top storey of the evergreen forest is composed of trees which generally raise their crowns well over the rest of the forest and unfurl their full foliage to the sun. The tallest tree in the picture is **Dipterocarpus indicus.**

Photos by the author.

Wind.—The direction of wind varies in different parts of the year but the prevailing direction during the rainy season is south-west. The following table shows the wind velocity and direction:

MONTHLY MEAN DAILY WIND VELOCITY AND DIRECTION AT HASSAN.

	Jany.	*Feby.*	*March*	*April*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Daily velocity in miles per day (Monthly Mean) ..	84	83	91	108	138	176	183	160	126	87	84	93
Mean Direction in 1936 ..	62 S.E.	27 S.W.	85 N.E.	87 S.E.	83 S.W.	77 S.W.	74 S.W.	80 S.W.	88 S.W.	63 N.E.	87 N.E.	88 E.

The influence of wind on the vegetation, especially during the dry summer months, is greatest on the peaks and ridges and owing to the fact that the rate of evaporation is accelerated by wind movement, makes its desiccating influence on the forest growth considerable.

General Description of the Vegetation.—When the evergreen forest is seen from an opposite elevated point in summer many differences between it and a deciduous one strike the eye. Unlike the latter, which is now practically leafless, the upper surface forms a richly varied mosaic in which every shade of green, and often variegated colours, are noticeable, the most frequent being the dark green (photo 1). By the mere tint of the foliage and the shape of the crowns an experienced forest-man can recognise some of the valuable trees. In a side view, also, the evergreen forest differs markedly from the deciduous one. Especially along watercourses, the stems, overladen with lianes and epiphytes, are often scantily visible; and the great diversity in the size of tree trunks, the irregular tangle of lianes and the variety of foliage crowns impress the eye. This lends to this forest its characteristic look of great disorder which contrasts it to the deciduous one.

It is also more difficult to obtain a clear view of the floristic composition of the vegetation. As regards large trees this is very laborious. Only felling the trees might help but this operation is sometimes rendered difficult owing to the lianes which bind them together. Felling may not always lead to the desired results for the large trees flower but seldom and that for a short time in the year. Attempts

at recognising a standing tree by the fallen flowers underneath it are often misleading as there is a possibility of the flowers and fruits dropping from the climbers. Some of the heavier climbers hide even their foliage from the ground and efforts to pull them down are useless. It is far easier to acquire the necessary knowledge of the underwood, several of the members composing this flower and fruit for many months in a year. The ferns, especially, could be easily identified soon after the rainy season when they bear abundant spores.

The Growing Season.—Although the forest is evergreen, the vegetative and reproductive activities of the plants are confined to a short time of the year. A glance at the seasonal distribution of rainfall and the rainfall graph (Fig. 2) shows that, most of the rain falls during the south-west monsoon between June and October; *i.e.* is confined to a short period of the year. Torrential rains now pour almost incessantly, the sky is constantly over-clouded and the temperature falls considerably. In other words, for about six months in the year, two growth factors are comparatively unfavourable for vegetative activity, *i.e.,* it is too damp and relatively cold. The ground surface is often flooded with water, thus impeding the respiration of the root system. The atmosphere is surcharged with water vapour, and this hinders free transpiration and photosynthesis and, lastly, warmth is comparatively inadequate. During the rains, therefore, little growth of the vegetation occurs. November and December have less rain, while, from January to May, there is little or no rain. The majority of forest streams and wells run dry and scarcity of water may often prevail. The atmospheric air is now drier and warmer and conditions are therefore favourable for vegetative and reproductive activities. The growing and the flowering seasons correspond, therefore, to the drier and driest parts of the year respectively. Fresh shoots start appearing in October. The height of the flowering season lies between the middle of January and the middle of March when, often, a pleasant odour emanating from innumerable forest flowers scents the air. The earliest to bear reproductive parts are the ferns, whose ample fronds fill themselves with sori already in December. The fruits start ripening in May and continue to do so well into the rainy season in June. The vegetative activities of most trees slow down again by the end of June,

The Vegetation—Zones of Growth.—Mr. H. G. Champion includes this forest region in his "Western Tropical Evergreen." It is found, according to him, all along the Western Ghats from about Ratnagiri District southwards where moisture conditions of air and soil are adequate.

The forest growth varies sharply according to elevation and aspect. Three distinct zones are readily recognisable among which the evergreen is the most conspicuous:

1. The zone of the semi-evergreen growth passing on to the deciduous one with decreasing elevation, below an altitude of 800 feet,
2. The zone of the rich, typically evergreen growth, from about 800 feet to about 2,500 feet,
3. The zone of the bare, grassy hill tops, above 2,500 feet.

It is not the elevation of the locality that sets a limit to the forest growth, but the outcropping of lateritic rocks consequent on the absence of soil, the high wind on the exposed ridges and occasionally fire. These factors often limit the vegetation to stunted or bushy growth or mere grass. From grass every transition may be seen to the typical shola forest growth as one descends a valley. The grass is first reduced by the lateral shade of overhanging trees. The bracken fern, *Pteris aquilina,* then fills up the space amidst the patchy growth of grass, along with semi-evergreen species like *Wendlandia notoniana, Eugenia corymbosa, Olea dioica, Linociera* spp., *Memecylon edule* and *Melastoma malabathricum*. Frequently *Strobilanthes* covers all the space and looks from an opposite hill like a light green ribbon lining the tree growth. Stunted evergreen trees follow *Strobilanthes* closely.

The altitude at the upper limit of the tree growth often varies considerably with aspect and exposure. It stands a hundred to two hundred feet higher on the leeward and northern and eastern aspects than on the wind-swept, sunny, western or south-western ones.

Occasionally an advancing fire sweeping up from the grass on the hill-tops may destroy all trees growing at the edge of the forest, except the bigger ones. Repeated fire may thus bring about a long

lasting check in the spread of tree growth. The large mother trees standing at the edge of the evergreen growth produce abundant seed from year to year but are unable to assist in the spread of the vegetation owing to want of suitable underwood for fostering the evergreen seedlings.

Under the evergreen bushes, where they exist, settle down seedlings of sub-deciduous and evergreen species like *Cedrela toona, Holigarna* spp., *Oroxylum* sp., *Alstonia scholaris, Macaranga* sp., *Ixora* sp., *Callicarpa* sp., etc., and these are gradually followed up by others like *Hopea wightiana, Cinnamomum iners* etc., to be finally replaced by *Dipterocarpus, Hardwickia, Mesua, Calophyllum* and such others. The upper limit of tree growth presents, therefore, a rapidly descending canopy.

While the transitions from the tall, evergreen, growth to the almost bare hill-tops is almost abrupt, that from the evergreen to the sub-deciduous and further down to the mixed-deciduous type is gradual and, frequently, almost imperceptible. The evergreen growth, especially in sheltered sholas with eastern aspect and traversed by perennial streams, descends along their margins to elevations of 500 feet or less. On the sunny, western slopes, on the other hand, the deciduous species are often common at elevations of 800 feet. In short, the evergreen growth passes more or less imperceptibly to the semi-shola. Among the trees which appear amidst the evergreen growth with decreasing elevation are: *Lagerstroemia lanceolata, Hopea parviflora, Bombax malabaricum, Stereospermum chelonoides, Sterculia foetida,* species of *Terminalia, Grewia, Xylia xylocarpa, Spondias mangifera* and *the Rosewood.*

FLORISTIC DESCRIPTION OF THE TYPES OF GROWTH.

1. *The Evergreen Shola Type.*—The general characters of the type have been dealt with in the preceding paragraphs. This type represents the climax of the tropical rain-forest formation. All available space from the ground level to the tops of trees is generally covered by a mass of green. It is typically storeyed, the tiers of growth, though occluded by the green foliage when one stands within the forest, are clearly recognisable in a cross-section such as what we find on the edge of a forest clearing. (Photo 3).

Fig. 5.

A comparatively young tree of **Diptero-carpus indicus,** about 104 feet high. Observe the dome shaped crown.

Fig. 6.

The canes occasionally form brakes along the water-courses. Observe how the climber **Combretum** sp. has practically strangled its supporter, a **Diospyros.**

Fig. 7.

Steep ground with the palm **Arenga wightii** growing above, and the fern **Angiopteris evecta** below.

Photos by the author

Within this type, which appears generally uniform, two distinct associations of species may be seen, controlled principally by the abundance of water in the soil. They are:

(*i*) Dipterocarpus-Vateria type, with *Dipterocarpus indicus* and *Vateria indica* as principal species and *Kingiodendron* (*Hardwickia*) *pinnatum*, *Mesua ferrea* and *Callophyllum elatum* as associates. This type occupies the hill slopes and valleys and covers by far the largest portion of the area.

(*ii*) Vateria-Elæocarpus type, with *Vateria indica*, *Elæocarpus tuberculatus* as principal species and *Calophyllum elatum* and *Mangifera indica* as associates. *Dipterocarpus indicus* is not entirely absent even here. This is an edaphic variant on the above and is found along the forest streams.

The top storey is composed of trees which, generally, raise their crowns well over the rest of the forest and unfurl their full foliage to the sun (Photo 4). Though, numerically, the trees of this layer form only a small percentage of the growing stock, yet they contribute most to give the vegetation its stately look and form. Most of these trees reach, when full grown, heights of 150 feet and girths of 14 feet and over. Among them are: *Dipterocarpus indicus*, (*Halmaddi*) (Photo 5), *Kingiodendron* (*Hardwickia*) *pinnatum* (*Yennemara*), *Vateria indica* (*Hagenmara*), *Calophyllum elatum* (*Bobbi*) and, occasionally, *Mangifera indica* (*Mavu*). In the rest of the growth which forms the bulk of the evergreen vegetation and displays a most confusing systematic array of species, the distinction into tiers of growth is not so obvious.

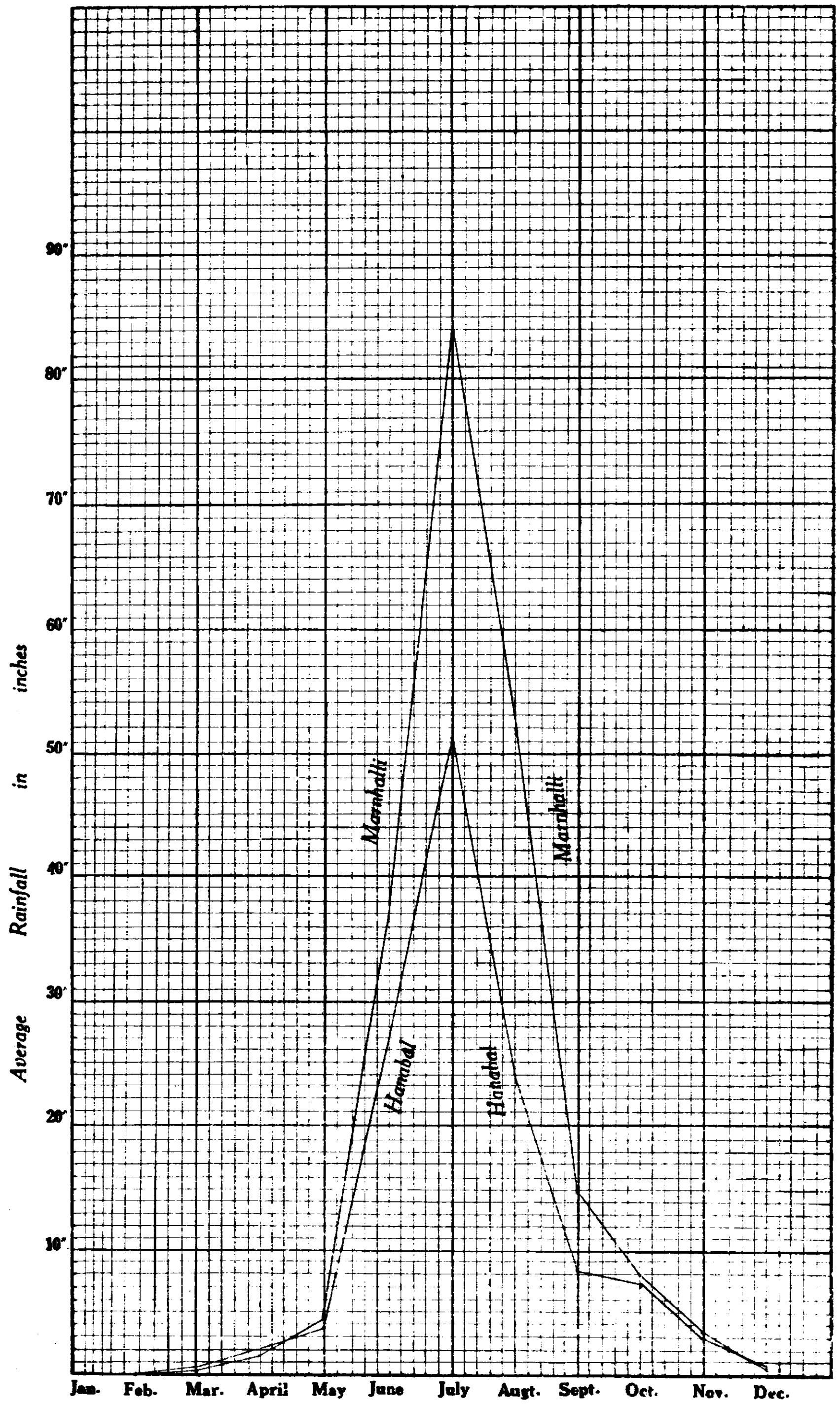
In the next storey are found *Mesua ferrea* (*Balagi*), *Vateria indica*, *Holigarna arnottiana* (*Tatageeri*), *Holigarna grahmii* (*Kutagiri*), *Hopea wightiana* (*Unnemara*), *Eugenia* sp. (*Malekunna*), *Antiaris toxicaria* (*Gaddahasave*), *Dysoxylum malabaricum* (*Devagare*), *Artocarpus hirsuta* (*Hasanumara*), *Cedrela toona* (*Nogavara*), *Canarium strictum* (*Raladhupa*), *Aglaia odoratissima* (*Kengavara*), *Lagerstroemia lanceolata* (Nandi), *Machilus micrantha* (*Battagumbala*), *Toddalia bilocularis* (*Devagare*), *Elæocarpus tuberculatus* (*Hanaltare*), *Diospyros* sp. (*Kabbalagi*), *Myristica Magnifica* (*Natwara*), *Bischofia javanica* (*Gobernerlu*), *Lophopetalum wightianum* and such others.

The third storey is composed of moderately large trees which fill up the bulk of the space within the forest with their abundance of species and individuals. Among them are: *Schleichera trijuga* (*Sagade*), *Artocarpus integrifolia* (*Halasu*), *A. lakoocha* (*Vatehuli*), *Alstonia scholaris*, *Myristica malabarica*, *Litsaea zeylanica*, *Litsaea glabra* (*Kirelehammadde*), *Cinamomum iners* (*Yelega*), *Nephelium longana* (*Malesagade*), *Litsaea wightiana* (*Hammadde*), *Anthocephalus kadamba* (*Kadavari*), *Garcinia cambogia* (*Mantahuli*), *Garcinia indica*, *Garcinia xanthochymus*, *Cinnamomum zeylanicum*, *Heynea trijuga* (*Kaggalli*), *Oroxylum indicum*, *Chrysophyllum roxburghii*, *Ficus* sp. (*Gargatti*), *Canthium* sp. (*Bilimandala*), *Semecarpus* sp. (*Geru*), *Trewia nudiflora* (*Katugumbala*), *Ostodes zeylanica* (*Balevara*), *Ficus* sp. (*Malegargatti*), *Michelia nilighirica* (*Karivala*), *Eugenia jambolana* (*Nerlu*), *Eugenia* sp. (*Malechaplu*), *Symplocos racemosa* (*Chumga*), *Carallia lucida* (*Torahalasu*), *Sterculia guttata* (*Jenukatlu*), etc.

Occasionally another distinct tier of growth is made up of smaller trees which form an underwood. Among these trees are: *Humboldtia brunonis* (*Yesagi*), which often is semi-gregarious, *Glochidion* sp., *Eugenia laeta* (*Gondechaplu*), *Memecylon edule*, *Macaranga roxburghii*, *Mallotus philippinensis* (*Husagi*), *Sterculia villosa* (*Maleupranti*), *Ixora parviflora* and *Ficus* sp. (*Kolla*). Among the shrubs and trees which generally occupy spots where, owing to a break in the canopy, light is admitted to the soil, are, in addition to *Macaranga roxburghii* and *Sterculia villosa* already mentioned, *Ixora coccinea*, *Trema orientalis*, *Pavetta indica*, *Gardenia* sp., *Leea sambucina* (*Vatebadakalu*), *Callicarpa lanata* (*Ibbane*), *Psychotria dalzelli*, *P. truncata*, etc. Into the vegetation of this tier has to be included the gregarious palm *Pinanga dicksonii* (*Geradalu*) which is found in patches amidst the underwood and stands not over 20 feet high, with a stem two to three inches in diameter.

The herbaceous plants are scanty in the denser portions of the forest where practically no light reaches the soil. A few ferns here and there are all that could be seen. Where some light reaches the soil appear a multitude of herbaceous plants, among which are the wild plantain, wild turmeric, wild ginger, cardamom, *Alpinia galanga*, *Clerodendron infortunatum* (*Taggalu*), species of *Peperomia*, *Amorphophallus*, *Commelina*, *Aneilema*, *Cyanotis*, many Gramineae

Fig. 2



Rainfall Graph of two recording stations close to the evergreen forest

and a number of ferns. The shrubs *Osbeckia chinensis* and *Melastoma malabathricum* are also frequently seen with their pretty reddish flowers at such spots.

Among the palms are, apart from *Pinanga dicksonii* mentioned above, *Caryota urens, Arenga wightii* and no less than four kinds of cane—*Calamus* spp. (*Handibetta, Vontibetta, Halubetta* and *Nimbebetta*) (Photo 6), which occasionally form cane brakes along watercourses. The canes, along with the screw pines of which there are two species—*Pandanus furcatus* and *Pandanus canaranus,* often choke up the beds of streams and make human passage across them nearly impossible.

Among bamboos, the genus *Oxytenanthera* alone is represented by no less than four kinds, known locally by the names *Bellote, Nujarote, Karote* and *Ameote.* Occasionally they form "brakes" along the watercourses.

The climbers are an important feature of the vegetation, especially along streams. A host of these are seen in the forest, whose systematic positions are yet imperfectly known. Among them are, apart from the climbing palms (Canes), already mentioned:—Gnetaceae—*Gnetum scandens;* Ranunculaceae—*Neravelia zeylanica* (*Serebilu*), *Clematis gouriana* (*Mandrikehambu*); Anonaceae—*Artobotrys zeylanicus;* Malvaceae—*Hibiscus furcatus* (*Muradalebilu*); Leguminosae—*Spatholobus roxburghii* (*Ujinabilu*). *Acacia sp.* (*Goddusigebilu*), *Dalbergia sympathetica, Caesalpinia* sp. (*Yethugatimullu*), *Bauhinia valhii* (*Basavanapadadabilu*); Loganiaceae—*Strychnos colubrina;* Araliaceae—*Heptapleurum wallichianum* (*Anagalubilu*); Tiliaceae—*Grewia* sp. (*Mudugaranabilu*); Rutaceae—*Paramignva monophylla, Lavunga scandens;* Convolvulaceae—species of *Ipomea* and *Convolvulus;* Menispermaceae—*Cocculus villosus,* and *Tinospora cordifolia;* Dioscoreaceæ—*Dioscorea alata,* Oleaceæ—*Jasminium sambac;* Rubiaceae—*Rubia cordifolia, Mussaenda frondosa;* Vitaceae, with about four species of *Vitis,* of which *V. latifolia* is one; Acanthaceae—*Thunbergia mysorensis;* Liliaceæ—*Gloriosa superba;* Araceæ—*Pothos scandens;* Poperaceæ—*Piper argyrophyllum* and others.

The ferns appear in large numbers and make a fine show, especially along road cuttings and steep banks, where an occasional landslip has removed the trees. Among them are: *Pteris quadri-*

aurita, P. geranifolia, Gleichenia dichotoma, Blechnum orientale, Angiopteris evecta (Photo 7), *Alsophila glabra,* species of *Nephrodium, Polypodium, Lastraea, Adiantum,* etc. Among the epiphytic ferns, the oak leaved fern, *Drynaria quercifolia* and the birds nest fern, *Asplenium* sp. are commonly seen on the trees. The aquatic fern, *Pleopeltis pteropus* var *minor* is occasionally found on submerged rocks in the streams. A host of liverworts and mosses appear, especially during the rains; among them are the genera *Riccia, Marchantia, Anthoceros, Fossombronia, Trichomanes, Bryum* and such others. The bark algae, *Chroolepus* and *Scytonema* are pretty common, and a host of fungi, too numerous to mention, develop their sporophores soon after the rains.

(2) THE SEMI-SHOLA OR THE SUB-DECIDUOUS TYPE:

This type follows closely upon the shola type at elevations generally under 800 feet. The shola passes on by almost imperceptible stages to the semi-shola type, which presents an intricate mixture of the evergreen species with the deciduous ones. Woods like *Dipterocarpus indicus, Kingiodendron* (*Hardwickia*) *pinnatum, Mesua ferrea, Elæocarpus tuberculatus,* etc., are absent from it, while *Hopea parviflora* and others make their appearance. The principal trees of this type are: *Vateria indica* (along streams), *Hopea parviflora* (*Kiralabovi*), *H. wightiana, Artocarpus integrifolia, A. hirsuta, Acrocarpus fraxinifolius, Lagerstroemia lanceolata, Grewia tilaefolia, Chrysophyllum roxburghii, Sterculia foetida, Garcinia xanthochymus, Schleichera trijuga, Bombax malabaricum, Eugenia jambolana, Erythrina stricta, mangifera indica, Spondias mangifera,* etc., along with one variety of cane and the palms *Caryota urens* and *Arenga wightii.*

The semi-shola type passes on almost imperceptibly to the typically deciduous one by the gradual disappearance of the evergreen species and the appearance of *Terminalia paniculata, T. belerica, Xylia xylocarpa, Pterocarpus marsupium, Dalbergia latifolia, Adina cordifolia* and others. The canes and palms are replaced by the big bamboo—*Bambusa arundinacea.* The bole heights of trees and the density of the vegetation diminish rapidly. The onset of the dry season is foreboded by heavy shedding of the leaves and the inflammability of the forests during this season becomes also great.

The Blanks.—Within the evergreen shola forest small patches of land may occasionally be found where scanty tree growth of a nearly xerophytic type occurs. Laterite frequently outcrops here at the land surface and little soil, fit to bear plant growth, may exist. The scorching effect of the sun on the bare rocks which rapidly absorb heat permits of no vegetation except the hardiest to survive here. One finds species like *Randia dumetorum, Randia* sp. *Phoenix humilis, Buchanania latifolia, Zizyphus xylopyrus, Zizyphus rugosa, Carissa carandas, Ixora* sp., *Mallotus philippinensis, Plectronia didyma* (*Canthium didymum*), *Capparis* sp. and such others. Grass and the bracken fern generally fill up the space between the patches of tree growth. At spots where water tends to stagnate during the rains, *Careya arborea* comes up abundantly.

Ecological factors.—Three ecological factors which react upon the vegetation impress one as one enters the evergreen forest. They are: *the struggle for light, the competition for space, and the need for moisture.* The struggle for light is most pronounced in this forest, as all available space is occupied by the green parts of plants, and each twig and leaf strives to assume as advantageous a position with respect to it as possible. This struggle finds expression in the comparative abundance of climbers and epiphytes. The former are perhaps the real winners in the upward thrust for light.

The competition for space arises owing to the great wealth of species and individuals. The space available for growth above the ground in this evergreen forest is considerable, as the trees are tall and clean boles up to a hundred feet and more are common. That below the ground, however, is relatively meagre as the forest stands on a somewhat shallow layer of soil and the ground is often quite steep. The root competition among the plants is necessarily severe. The root system of even the tallest trees stands generally shallow and, if the forest is unduly thinned, the effects of wind on the larger trees are often disastrous.

Though, on entering the forest, one is struck by the abundance of humidity, yet not all the vegetation is placed in a favourable position with respect to it. While during the rainy season there is superabundant moisture in the soil and the level of the subsoil water rises to the ground surface and overflows wherever an outlet

is possible, in the dry season the subsoil water level sinks often fifty feet or more into the ground and many of the forest streams dry up, while those that persist have poor flow. The sun during summer pours a nearly uninterrupted flood of light and heat on the tree tops which present an almost unbroken green canopy, and its desiccating effect demands considerable protection against excessive transpiration from the exposed leaves. Strong, well developed, cuticles and stomata sunk into the mesophyll are therefore the rule in these leaves. The cuticled leaf surfaces mirror the light of the sun in summer and dazzle with their brilliance the eye of the camera. Under the forest canopy reign comparatively humid conditions. The air constantly retains a considerable amount of moisture and this, in addition to the unbroken shelter from the sun, permits of the development of shade bearing species, ferns and the seedling regeneration of the trees which later dominate the canopy. The adequate moisture and the fertile soil are very favourable for plant life and there arises, therefore, a keen struggle for light, in which those that could grow tallest gain the upper hand. As, owing to the evergreen canopy, very little light reaches the soil, the seedlings of the evergreen trees acquire remarkable power to persist in shade and withstand the competition for space. Even after indefinite suppression, the seedling and advance growth of the tree species in evergreen forests respond better than those in the deciduous ones to relief from congestion and influx of light.

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SUCCESSION IN PLANTATIONS OF LIGHT-CROWNED SPECIES

BY P. N. DEOGUN, D.F.O., MONTGOMERY.

Mr. Smythies has done a great service by pointing out the fact of invasion by share-bearing species in plantations of light-crowned species in a leading article in the *Indian Forester* for April 1938.

This fact was noticed by the Punjab Forest Officers years ago as noted by Mr. Smythies about Chhanga Manga, the oldest of the Irrigated Plantations. Somehow it was not realised till very late that these shade-bearing species could be other than mulberry which had proved a blessing in disguise for the Punjab, nay for the whole of India, not only by providing a good revenue to the Forest Department but by providing employment to thousands of families.

The fact that the invasion by the shade-bearing species in the Punjab Irrigated Plantations could be by species more harmful than mulberry had proved useful, was realised when thousands of acres had been invaded by *dab* grass (*Eragrotis cynosuroides*) and *Imperata* in Khanewal, Miranpur and Dipalpur plantations and serious irrigation difficulties were encountered and restocking of these *dab* and *Imperata* infested blanks had become a problem.

This invasion was helped to a great extent by the introduction of *frash* (*Tamarix articulata*), a very light-crowned species, whose demands on water and soil were thought to be meagre.

In Khanewal several hundred acres, where shisham was not considered to be doing well, were abandoned by stopping their water-supply and stocked with *frash*. Unplanted (new) areas were also planted with *frash* only. *Frash* did not give the desired success. *Frash* has a fastidious taste and will not grow where one thought it will or where one desired and tried to force it to grow. *Frash* had been tried in Chhanga Manga and Kot Lakhpat plantations but never formed regular crops. Later work with *frash* merely proved what had been found previously to be the case with this species. Nowhere did it form a complete canopy. Even in a few patches where it succeeded very well it soon opened out. In other places it failed, got overgrown and suppressed by shisham coppice that had been kept down by cutting back year after year, or grew in singles or groups of a few.

In the new areas where *frash* had failed efforts were made to introduce shisham but the success was poor due to the changed frost conditions. Shisham was bitten by frost.

This latest *frash* era when *frash* really ruled the plantation ideas lasted for about seven years.

During the time the *frash* was permitting the formation of gaps, Nature was not idle with the amount of heat and water available and it soon introduced *dab* and *Imperata* in these blanks and open crops which began to threaten the adjoining good shisham areas. The control and eradication of this *dab* and *Imperata* became a serious problem and in 1934 *dab* control experiments were started.

Dab forms big colonies higher than the height of an average man, blocks the irrigation trenches not only directly but indirectly also through rat earth as the rats are common in such areas. In addition *dab* affords fine shelter for snakes, so much so that these areas are also styled " Cobra areas." Inspection of irrigation of such areas, if not impossible, is difficult and risky. The common *beldar* and the forest guard who look after the irrigation consider their lives more valuable—and rightly so—than the welfare of a few trees in such areas.

Several species were suggested and tried to control the spread of *dab* and to eradicate it, *viz.*, *Adhatoda vasica*, *Ipomoea carnea*, *Cordia*

Photo No. 2.

Shisham area invaded by *dab.* Under and interplanted with mulberry and *bakain* (seen behind the figure) 12 months old.

Photo No. 1.

One of the abandoned areas planted with *frash* which failed leaving behind '*dab.*' Now being taken up for *dab* control after permitting grazing therein.

Photo No. 3.

Transplants of *bakain* put out 3 years ago in a bad *dab* area in Khanewal Plantation. *Dab* has vanished from under the *bakain,* but is present in a gap in front of the trees.

obliqua, Rhus lancea, Leucaena glauca, Sesbania aegyptica, elephant grass, etc. The choice was limited to species that could stand extremes of temperatures, namely, 140°F. to 17°F., could stand the root competition with these grasses, had a good foliage and power to check the further spread and oust these grasses. The required qualities were found in the two species which were not unknown in the plantations, *viz.,* mulberry (*Morus* sp.) and *bakain* (*Melia azedarach*). The real success lay in the method of their raising and propagation. Photo No. 1 shows a *dab* area after a few months of grazing and being taken up for planting. Photos Nos. 2 and 3 show a *dab* area after a year of planting with *bakain* and mulberry which are showing so well. After two years' experience one can say that the *dab* in areas successfully planted is already showing signs of deterioration and it will not be long before it vanishes.

The Punjab should be thankful to the great interest taken by Mr. Parker, the Chief Conservator of Forests, in this problem, which we appear to have solved. To quote Mr. Parker's remarks dated February 1937, "We appear to have found the method of dealing with bad *dab* areas. Very heavy grazing clears the grass. Poor shisham and poor *frash* can then be underplanted with *bakain.* The better shisham and good *frash* being underplanted with mulberry and blanks with *kallar* showing can be planted with *Prosopis.* These operations will, I think, suffice for all except the very worst areas. In these it may be useful to plant *Ipomœa* cuttings and *Rhus lancea* as well as *bakain.*"

As a routine measure all areas after I and II thinnings are under and inter-planted with mulberry and *bakain.* Mulberry is put out in better areas with tree growth, *bakain* in open gaps or in areas too poor for shisham and mulberry, *Prosopis* in *kallar* (saline soil) and *kappar* (hard clayey soil). Work is in progress to find out other suitable species fit for underplanting. The magnitude of the work can well be gauged from the fact that during the three seasons of 1936, 1937 and 1938 as many as 37,00,000 (or a million and a quarter per year) stumps and plants, mostly of mulberry and *bakain* and to a small extent of *Prosopis* spp., Osage-orange, *Rhus lancea, Celtis eriocarpa,* etc., were put out in addition to the direct sowings covering hundreds of acres.

The success with mulberry stumps and *bakain* transplants is very high—say 90 per cent. The average cost per acre worked out to about Re. 1-4-0. To this may be added the cost of a little extra water required and the cost of raising of plants in nurseries which covered about 80 acres at one time. Considering the amount of good it has done, the cost is negligible. This has not only checked the invasion by *dab*, etc., but has improved the condition of the existing crop by covering up the soil and will add to the yield per acre. The Inspector-General of Forests, in his last inspection note, dated November 1937, observed:

"It appears to me that this work has been of the greatest benefit to the plantation. It seems to have altered the whole appearance of the plantation, to have prevented early leaf fall and to have greatly increased the fertility of the soil and the production capacity of the area . . . . This underplanting has solved the *dab* problem."

The main object of this note is to show the necessity of keeping the cover complete, instead of waiting for Nature to do the work which may run out harmful. It is better to spend a little and introduce what is known to be the best at the time of first thinnings or earlier if need be.

A NOTE ON THE OCCURRENCE OF TAIWANIA CRYPTOMERIOIDES IN BURMA AND ITS UTILISATION FOR COFFIN BOARDS IN CHINA

By C. W. D. Kermode, Silviculturist, Burma.

In the *Indian Forester* for October 1933, page 691, was printed an extract from the Notes from the Royal Botanical Garden, Edinburgh, Volume XVIII, Number LXXXVI, April 1933, concerning the occurrence of *Taiwania cryptomerioides* in Burma. Sheets of the specimen (Lace No. 52) were found in the Maymyo herbarium and by their aid it was possible to identify four trees of this species which are growing in the Botanical Gardens, Maymyo, and which had been incorrectly named *Juniperus recurva*. These trees were apparently brought down as seedlings from the North-East Frontier before 1920. The trees are flourishing, the two biggest being 51 feet and 44 feet

Taiwania Cryptomerioides in the Maymyo Botanical Gardens.

Photo by Mr. David
6-11-1938.

high and having breast-height girths of 4 feet 8 inches and 4 feet 3 inches respectively. They are of very handsome appearance. (Plate 22.)

Early in this year the writer was touring on the North-East Frontier of Burma and from information gained there has come to the conclusion that it is from this species that the coffin boards which are so valued by the Chinese are hewn.

Kingdon-Ward, in his book "In Farthest Burma," makes reference to this export of coffin planks. He states that the tree employed is a juniper which reaches a height of 150 feet with a girth of 20 feet at the base. He also states that it is not found in the Ngawchang valley below 6,000 feet nor much above 8,000 feet and that it occurs scattered or in groves probably all up the North-East Frontier. He came across the finest specimens in the neighbourhood of the Wulaw Pass.

In "Farrer's Last Journey," Cox also mentions this trade and refers to the tree as a juniper. Both Kingdon-Ward and Farrer visited the village of Kangfang on the Ngawchang *hka* through which these boards are transported from the upper reaches of the Ngawchang.

In the "Plant Introductions of Reginald Farrer," reference is made under the heading of *Juniperus recurva* to the "Coffin Tree." The author is apparently in doubt about the correctness of this naming.

In *Country Life* for November 9th, 1935, is an illustration of *Juniperus coxii* which is said to be highly valued by the Chinese for making coffins. The illustration depicts a much more lightly foliaged young tree with more slender branchlets than *Taiwania*. It is described there as being a "slender elegant thinly branched tree with gracefully pendant branches and sharply pointed leaves borne in threes at each joint and each $\frac{1}{4}$ inch to $\frac{1}{2}$ inch long." This juniper is presumably the tree mentioned above under the name of *J. recurva*.

The writer spent some days at Kangfang village at the end of April last year and while there made enquiries about the species which is used for coffin boards and was able to obtain specimens. One specimen was obtained from a tree planted near the village, another

was obtained through the headman of Kangfang from a spot several days' march beyond up the Ngawchang *hka* (probably the place referred to by Kingdon-Ward). A third specimen was brought in by a collector from a hill about ten to twelve miles north-east of Kangfang and not very far from the frontier. The headman of Kangfang and several other local people stated definitely that it was from this species that the boards were obtained. These specimens have been identified as *Taiwania cryptomerioides*. A planted tree of this species was noticed growing behind the bungalow at Htawgaw. Enquiries made in that place also brought forth the information that this was the coffin wood tree. There is little doubt left in the writer's mind but that this is a correct identification.

At the same time at least one species of juniper does occur in these hills at about 8,000 to 10,000 feet and one very large old tree was seen a few miles short of the Chimili Pass. This tree was probably 12 to 15 feet in girth. It differed from *Taiwania* in having its leaves in whorls of three and in having the typical juniper berry. It is very likely that this is *J. coxii*. The local people stated that it was not used for making coffin boards.

It appears that all the coffin board trade passes through the village of Kangfang. These boards have to be brought by coolies from up the Ngawchang *hka* on the west bank. Kingdon-Ward states that they are also floated down as far as Kangfang. From Kangfang they are taken either by mule or by coolie into Yunnan. Both methods of transport were seen. A good strong mule can manage two boards but one appears to be the usual load of the smaller mule. Boards are about 7 feet long 3 feet 6 inches wide at the top tapering to probably 3 feet at the bottom and from 3 to 4 inches thick. They must weigh quite 70 to 80 lbs. From Kangfang they are taken over to Yunnan *via* one of the passes. Coolies were met taking them over the Hpimaw Pass road and the Fengshuiling Pass road. To reach the frontier *via* the Hpimaw Pass a distance of 23 miles from Kangfang has to be traversed and an ascent to about 10,500 feet made. The distance to the Fengshuiling Pass is greater (about 41 miles) but the height is less (8,500 feet). The carriage of these boards must be a very severe strain on the coolies. A party of them was met on the Hpimaw Pass. At this height they had to halt at very short intervals for rest.

NOTE ON THE RHINOCEROS CAPTURED DURING LAST OCTOBER FOR THE AMERICAN ZOO

BY M. C. MIRI, EXTRA ASSISTANT CONSERVATOR OF FORESTS.

It is believed that there are about a hundred rhinoes living at present in the Kaziranga Game Sanctuary, an area of about 165 square miles, stretching between the longitudes 93 degrees, 7′ 30″ and 93 degrees, 35′ to the west and east respectively and the Brahmaputra river and the Mikir Hills to the north and south respectively. The captured rhino was one of those living in the Sanctuary though actually caught just outside it.

The last flood of the Brahmaputra during July was a record one within memory and good many rhinoes, not to speak of other animals, swam across to the Mikir Hills in search of land and safety. Most of the rhinoes went back to the Sanctuary after the flood had receded but the one captured never returned and made the Mikir Hills its home since it found itself in them after a long and hard swim in the afternoon of the 25th of July 1938.

Officiating Forester Basanta Kumar Baruah found it on that day near Sildubi (26 degrees, 35′ latitude by 93 degrees, 20′ longitude), a village on the Trunk road which, at that point, skirts the Mikir Hills. The Forester and the villagers watched it for about an hour as it stood almost motionless due to exhaustion. As there were no ropes near at hand, the Forester could not do anything to capture it then and there. The writer of this note accidentally arrived there the same day at sunset but by then the animal had gone a long distance into hills and nothing more could be done. An attempt was made the next day to track it down but without success. Another attempt was made on 8th August 1938 with the same result. On 13th October 1938 while the writer was making personal enquiries regarding damage done by rhinoes to the villagers' crops, he was informed that the young rhino was coming out every night to the villagers' paddy fields near Sildubi. Deputy Ranger Govinda Chandra Thakuria was sent ahead to find out the track, or tracks, by which it used to come out and return. He found out the tracks, of which one was found to be suitable. He was instructed to dig a pit on this track and two or three more pits on other tracks,

if found suitable, as early as possible. Three pits were dug on the 16th. Each was 9 feet long along the track by 3 feet by $4\frac{1}{2}$ feet deep and the walls were protected by bamboo pallisade work as the soil was sandy. The pits, normally, ought to have been 6 feet deep but as the animal aimed at appeared to be young and no other animals were near-by they were made only $4\frac{1}{2}$ feet deep. The country being low, the water level also limited the depth. The mouth of the pit was covered up with grass and made to appear as nearly as possible like the rest of the track. As there is a belief among the local people that a rhino can scent newly dug out earth from a considerable distance, it was deposited at a distance of about a hundred feet from the pit.

As nothing further was heard, the writer became anxious and came to the place on 20th October 1938 to see if anything was wrong. He did not have to reach the place before hearing where the mistake lay, for he was informed on the way that the young rhino had fallen into the first pit the previous night and had scrambled out before dawn. On enquiry in the village it was found that the rhino had come out just at dawn to a paddy field the same morning. It also became apparent that it had not gone back to the Sanctuary which is across a small stream. So the Deputy Ranger was instructed to increase the depth of the remaining two pits to 6 feet and to dig two more pits in suitable places.

Nothing was heard up to the 25th and the writer made up his mind to go and make the attempt personally, camping near the place for some days. On 26th morning it was found out that the rhino never lived in the grass jungle round about the paddy fields during the day contrary to what was believed to be the case and actually was in the habit of coming down to the field for grazing and returning to the hills every night. The previous night's spoors up the hill were followed to a height of about a thousand feet where it was lost among the maze of older tracks made since it came there during the flood. Two suitable tracks were found and a pit was dug on each, by the side of the road where the tracks crossed the road. Forester Abdus Sattar was ordered to camp in the village only a furlong off. Next morning, to the disappointment of all, it was found that the rhino had come very close to one of the newly dug pits, while coming downhill, but had turned back. The worst

suspicion was that it had scented danger and would never come that way again and even worse than that was that it might leave the place for the Sanctuary by some other way. If this had happened the hope of catching a particular rhino out of so many would be nil and the only thing that could have been done was to trap as many rhinoes as possible and select the best. The spoors were traced uphill again to the same place where it was lost. After a thorough inspection of the place it appeared that the rhino had not gone away from the locality and it was decided to wait till next morning in order to see if it would come down at all and if so by which way. The Forester was given two Game Watchers, Joygoram Koch and Maniram Ahom and was instructed to watch by night also. The writer himself camped eight miles off at Kaziranga. The hope of catching the rhino appeared to be very lean now. Next morning, *i.e.*, on 28th October 1938, the writer packed up everything for going back to headquarters and came to see what had happened before actually going back. Perhaps the most exciting experience during the whole operation was when, on the way to the place, a man on a bicycle making certain that it was the writer, raised his hand trying to stop him. He rightly guessed what it meant and of course stopping the car was out of the question. Instead the rest of the road, about five miles, was done most probably in as many minutes. The Forester was found near the pit and the two Game Watchers carrying fodder to the pit. What more assurance was necessary? It was about 7 a.m. and the rhino was found lying down at the bottom of the very pit from which it had turned back the night before the last.

Arrangements were immediately made to bring the cage to the spot and to put the animal into it. Thanks to Mr. H. L. Shaw of Methoni, a motor lorry was at once found and the cage arrived at the place in the evening. In the meantime, the rhino was eating fodder supplied and drinking water out of a fire bucket that was lowered into the pit by means of a rope. The cage was brought into line with the pit and a slope was dug from the door of the cage to the bottom of the pit hoping that the animal would run into the cage as soon as the slope was ready for it. It was, of course, made secure by a rope round its neck and by another one round its body and the ropes were tied to trees near-by. When everything was made

ready for the rhino to run into the cage it was found that it would not do anything of the sort. On the contrary it lay down and refused even to get up in spite of pokings from behind. At last it had to be dragged out from the pit into the cage by men. It was very nearly 1 o'clock in the morning by the time the rhino was secured inside the cage. It did not struggle very much inside the cage and fell to eating and drinking as if it were in its normal habitat.

Next morning it was found that there was a wound in its chest which must have been caused by the bamboo pallisades while falling into the pit in the night of 19th October 1938. When the writer wanted to inspect the wound, to the utter surprise of all, it opened out its forelegs to facilitate inspection and treatment. On another occasion it lay on one side and opened out its hind legs, exposing a number of big ticks sticking to the skin in the pits, When these were being removed, satisfaction was apparent in its eyes and it remained in that position until all the ticks were removed.

The cage with the rhino was loaded on a motor lorry next day. It struggled to get out of the cage during the first ten minutes of its motor ride and then settled down. Though it did not feed while the lorry was actually in motion, it did so as soon as the lorry stopped.

Some delay was caused by the Railway people and the animal was actually despatched from Furkating Junction only in the morning of 2nd November 1938. Forester Abdus Sattar and Game Watcher Joygoram Koch accompanied the animal to Calcutta. Fresh fodder was arranged for on the way and the rhino was washed with cool water twice a day.

KILN-DRYING OF LIGHT HARDWOODS FOR PACKING CASES

BY S. N. KAPUR,
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Forest Research Institute, Dehra Dun

Summary.—Results of an investigation into the kiln-drying of light hardwoods for packing cases carried out at a seasoning installation recently built in Assam are briefly described. The drying time for ½ inch thick *tula* (*Tetrameles nudiflora*) shooks was found to be as low as 30 to 36 hours. The cost of kiln-drying for an output of 120 tons of ½ inch shooks per month comes to less than one anna per cubic foot. For heating and power purposes, the waste obtained in the factory is usually sufficient both for the mill and the kiln.

With the industrial development of the country, the demand for packing cases is rapidly increasing. In and around Calcutta, there are numerous big industrial concerns engaged in the manufacture of shoes, matches, soaps, chemicals and toilet preparations, pencils, pen-holders and articles of stationery, paints and varnishes, electric batteries and a host of other articles. There are also jute factories, paper mills, and the tea packing industry, all of which consume large quantities of wood for packing purposes. This demand is met partly by import of dealwood in the form of planks or finished box shooks, chiefly from Japan, Yugoslavia and British Columbia, but indigenous woods are also finding a substantial market. In Calcutta alone, the consumption of wood for packing cases is estimated at not less than 100 tons a day of converted material. The biggest consumers are perhaps the Bata Shoe Factory who require about 1,000 packing cases a day, equalling about 20 tons of converted material.

2. The primary requirement of a wood suitable for packing cases is its lightness. Any wood weighing about 22 to 26 lbs. per cubic foot in air-dry condition is accepted by the users, while the heavier woods are rejected, on account of the fact that an increase in weight of the wood adds to the freight charges, which are considerable as the manufactured articles have to be transported over long distances by rail. The chief woods in demand in Calcutta market at present are, semul (*Bombax malabaricum*) and *tula* (*Tetrameles nudiflora*), while *geon* (*Excœcaria agallocha*) is also used for cheaper packing cases. Semul is imported from Eastern Bengal and Assam in the form of logs, while *tula* comes mainly from Assam in the form of finished box shooks. The users demand that the wood should be reasonably dry and free from insect and fungus attack. Bigger firms usually require the wood to be supplied in the form of box shooks, made to suit their particular requirements, which vary from time to time. The wood for box shooks is usually planed on one side, and the pieces forming one side of a box are joined by dowels, edged and trimmed, so that very little labour is required in assembling the packing cases.

3. The light woods used for packing cases require rapid seasoning, in order to avoid damage from stain, rot and insect attack. For air-seasoning the usual method recommended is vertical

stacking in the open, which requires a large yard area. In dry weather, a week to ten days' stacking in the open brings down the moisture content to a sufficiently low level for the manufacture of box shooks, but the difficulty comes in the rainy season when it becomes very hard to avoid discoloration of wood due to the growth of mould and fungi. The freshly sawn material left closely stacked for even a day gets badly discoloured.

4. The kiln-drying of wood for the manufacture of packing cases has, therefore, many advantages. A few of these are enumerated below:

(1) Large saving in yard area.
(2) Reduction in drying time.
(3) Prevention of staining and fungus attack of wood during seasoning.
(4) Considerable saving in freight on the transport of finished box shooks from the sawmill to the user.
(5) Ensuring freedom from stain and fungus of box shooks during transport and storage.
(6) Ability to meet immediate orders for shooks of different sizes, as the period from the saw to the finished shooks is reduced to less than a week.

5. Numerous enquiries were received during the last two years for advice and help in the matter of kiln-drying of light hardwoods for packing cases, and two large installations have already been erected in Calcutta and one in Assam. Detailed plans have been supplied to two more firms, one of which is for an installation with a drying capacity of about 20 tons of converted material per day. The indications are that this industry is likely to expand greatly in the near future.

6. An investigation was recently carried out on the kiln-drying of packing case woods at the newly built kilns in Assam, with the object of determining the optimum conditions of drying these woods and also improving the design of kilns to enable drying being carried out as rapidly as possible. The installation consists of two internal fan, reversible circulation, kilns, each drying chamber being 20 feet long, 11 feet wide and 10 feet 6 inches high. Each kiln is equipped with 3 propeller fans of 36 inches diameter which are run by a 3 h.p. electric motor. There are two steam heating

coils in a kiln, with a total heating surface of 230 square feet. Fresh air and exhaust outlets of sufficiently large area are provided to get rid of the evaporated moisture. With $\frac{1}{2}$ to $\frac{5}{8}$ inch thick material and $\frac{3}{4}$ inch thick crossers, about 380 cubic feet of sawn material can be stacked in each chamber.

7. A number of trials were carried out and it was found that for drying absolutely green material containing initially about 100 per cent. to 150 per cent. moisture to a final moisture content of about 10 per cent., the process can be completed without any difficulty in the following periods:

Tula (*Tetrameles nudiflora*) $\frac{1}{2}$ inch to $\frac{5}{8}$ inch thick: 30 to 36 hours.
Ditto. $\frac{3}{4}$ inch to $\frac{7}{8}$ inch thick: 60 hours.
Semul (*Bombax malabaricum*) $\frac{1}{2}$ inch thick: 48 to 52 hours.

In all cases it was found that the drying was uniform and no cracking, splitting or damage from any other seasoning defect was noticed. The steam consumption was determined at 1.3 to 1.4 lbs. of steam per pound of moisture evaporated from the timber. The steam required for the kilns was supplied from the existing boiler, which runs a big steam engine for working the mill. For generating steam nothing but wood waste was burned in the boiler, and the quantity of waste available in the form of sawdust, shavings, trimmings, edgings, etc., was more than sufficient to run a separate boiler for the timber drying kilns. The current consumption for each kiln was found to be about 8 amps. at 220 volts for running the fans at 550 r.p.m. The electric current was supplied by a small diesel engine generating set used for lighting the mill for working during night shift.

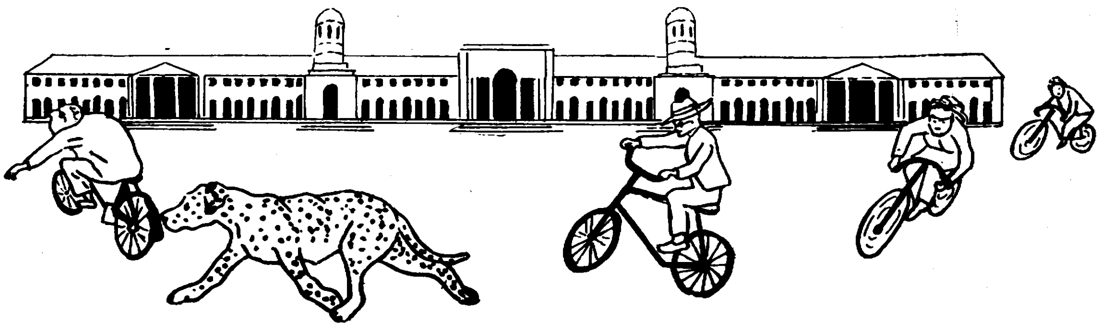
8. The cost of kiln-drying woods for packing cases is very small indeed. In a mill engaged in the conversion of light hardwoods into packing cases, there is usually ample wood waste to work the entire mill and to supply steam and power to kilns as well. The extra expenditure involved in operating the kilns consists of (*a*) labour charges for stacking and unstacking material in the kiln, (*b*) pay of the kiln operators and (*c*) interest and depreciation charges on the capital cost of the installation. If the mill is working during day time only, extra staff has to be appointed on the boiler for the night shift also. The initial cost of the installation at the Assam mill was

estimated at Rs. 6,000. For stacking timber in a kiln, eight men were required and the work could be finished in about 16 hours. The unstacking could be done by eight men in less than eight hours. Taking 48 hours as the average drying period and adding the time required for stacking and unstacking, the total duration in a kiln is about 72 hours for a charge. This would give 10 charges per month, but allowing for stoppages, etc., eight charges per kiln could easily be handled in a month. The two kilns would then give a monthly output of 16 by $7\frac{1}{2}$ tons = 120 tons of dried material. The monthly expenditure is estimated as follows:

		Rs.
(1)	Labour for stacking and unstacking 16 kiln charges, at annas six per man per shift	144
(2)	Three operators at Rs. 40 p. m. each	120
(3)	Interest and depreciation at 10 per cent. per annum, on Rs. 6,000	50
(4)	Boilerman and fireman for the night shift ...	30
(5)	Lubrication and minor repairs	16
	Total ...	360

9. The cost of drying, therefore, comes to Rs. 3 per ton of dried material, or a little less than one anna per cubic foot. As against an expenditure of Rs. 360 per month for operating two kilns, the cost of labour alone for stacking and unstacking the same quantity of sawn material in the yard, I was told, was not less than Rs. 400 per month. Kiln-drying of packing case woods has, therefore, the further advantage that it is more economical than air-seasoning, in addition to other benefits mentioned in paragraph 4 above.

10. There are extensive possibilities for the manufacture and supply of box shooks for packing purposes in Assam, Bombay (Western Ghats), Madras (Western Ghats), Mysore, Coorg and Kashmir and to a smaller extent in Central Provinces, Bihar, Orissa, United Provinces and Hyderabad (Deccan). Large quantities of soft-woods are being imported for this purpose, which can be replaced by our indigenous woods. The matter, therefore, is recommended to the attention of provincial and state forest departments and of industrialists in this country.



RHYMES OF THE F. R. I.

Slimming News.

Four Forest Officers—faces full of woe—
Girth Increment's the trouble—WHAT will they do?
"Mine's forty-seven, and yours is forty-four."
"And mine is nearly fifty-two!" cried Hari Singh and Bor.
"I shall get a bicycle" and "So shall I!" they cried.
"To and from the offices, every day, we'll ride."
Four Forest Officers, riding to and fro,
Round and round the Institute, then back to lunch they go.
Four Forest Officers—bicycling with glee . . .
A spotted dog chased one . . . and then there were three.
Three Forest Officers—on bicycles they flew . . .
One forgot to ring his bell . . . and then there were two.
Two Forest Officers—reduced to skin and bone . . .
One declined so rapidly that now there's only one.
One Forest Officer . . . reduced to twenty-one
Centimetres round the waist . . . so now there are none.
Round and round the Institute, round and round they go—
Ghostly Forest Officers, riding to and fro.
Ghostly Forest Officers—shadowy and svelte
"Oh! THAT'S the way" (you 'll hear them say)
"to make the waist-line melt"
Pale ghosts of Forest Officers—yet HAPPILY they sing—
Garland—and Laurie—and Bor—and Hari Singh!

TIMBER PRICE LIST, FEBRUARY-MARCH 1939

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 48-0-0 to 84-0-0 per ton.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-15-7 to 1-3-3 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 1-0-0 per c ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-7-0 per piece.
,, ..	,, ..	Punjab ..	12′×10″×5″ ..	Rs. 4-8-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-12-0 per piece.
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	
,, ..	,, ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
,, ..	,, ..	Punjab ..	9′×10″×5″ ..	Rs. 3-10-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	9′×10″×5″ ..	
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
,, ..	,, ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 1-2-0 per c.ft.
,, ..	,, ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-4-0 to 0-13-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-3-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 52-0-0 to 90-0-0 per ton.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-0-0 to 1-2-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-12-0 to 1-4-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-2-0 to 2-5-0 per c.ft.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 0-8-6 to 1-4-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 2-6-9 to 6-1-3 per c.ft. in round.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 3[illegible]-4-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-3 to 5-4-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-8-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 33-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per scantling.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-12-10 to 1-6-0 per c.ft. in round.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 0-14-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 0-13-4 to 2-2-4 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-8-0 to 2-10-4 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-8-0 to 2-10-0 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	..

EXTRACTS

CURRENT MONTHLY RECORD

The following Introduction is extracted from the Current Monthly Record of Forestry Literature for January 1939 (*No.* 32), *published by the Imperial Forestry Bureau, Oxford*:

"As will be evident from our new cover, the *Current Monthly Record* has now been taken over by the Imperial Forestry Bureau.

The only change in this issue is the introduction of revised subject headings conforming to the International Decimal Classification Index Number 634.9F, recommended by the International Committee on Forest Bibliography. The decision to adopt this system was taken after very careful consideration. The classification is by no means ideal, but after three years' experience of it in the Documentation Section of the Imperial Forestry Institute we believe it to be workable for the purposes of the Bureau; and feel that after all the labour that has been expended in framing the classification, and securing its acceptance internationally, we should do all that is possible to make it a success. A recent revision has removed many of the more serious defects of the original plan.

In the February issue we shall introduce some other changes of a minor character, concerned mainly with the adoption of standard abbreviations for the particulars given of each paper recorded.

Whether, and for how long, the *Current Monthly Record* will be carried on in its present form is a matter of Bureau policy which

must be left over for decision pending the arrival of the Deputy Director: the appointment to this post is unlikely to be made for some weeks. While, as a publication, it may not be easy reading to the forester in the field, we believe that it is useful to forestry libraries and institutions in bringing the latest literature promptly to their notice. As far as the Bureau is concerned, the *Current Monthly Record* represents the first stage in sifting the mass of incoming literature to determine what material is, and what is not, worth permanent record. During the process of its compilation it is noted what papers appear *prima facie* to be worth abstracting, and the preparation of abstracts of papers that have been recorded for inclusion in the *Current Monthly Record* will constitute the second phase of the work. It is probably not realised by the average forest officer how large is the volume of literature to be examined: the *Current Monthly Record* contains only a selection of it, and the abstract periodical to be published by the Bureau will not be able to deal with more than a selection from what appears in the *Current Monthly Record*. Moreover literature in the lesser known foreign languages like Russian, the examination of which has not hitherto been attempted, will add considerably to the total volume passing under scrutiny.

The Bureau has been at work with a nucleus staff since October 1938, and some experimental abstracting work has been done. The form in which abstracts will be published is another question of policy still to be decided, but it is probable that an abstract periodical will issue quarterly, beginning with literature published in 1939. In addition, the practice of the other bureaux of the International Agricultural Bureaux Organisation will no doubt be followed of publishing "Technical Communications," in which the literature bearing on a particular subject, or line of research, will be reviewed.

Further information regarding future plans will be communicated as and when they mature. Meanwhile the following quotation from the Annual Report of the Imperial Forestry Institute for 1937-38 may help to a clearer idea of the status and functions of the Bureau:

"The service of information, which it was contemplated from the outset that the Institute should provide, but which could never

be properly organised for lack of adequate funds, will be supplied by a separate Imperial Forestry Bureau to be set up under the Imperial Agricultural Bureaux organisation. This will be independent of the University, but liaison will be secured by placing the head of the Institute in general control of the Bureau with the title of Director: a Deputy Director will be in executive charge. The function of the Bureau will be to examine the forestry literature of the world and present its more important contents in assimilable form for the information of those engaged in the practice or study of forestry, and the resources of the University forest library will be at its disposal for this purpose."

ADHESIVES EMPLOYED IN MANUFACTURING PROCESSES FOR PLYWOOD AND VENEERS

The following extract from an article in the *Timber Trades Journal* of 7th January 1939, on "Adhesives employed in Manufacturing Processes for Plywood and Veneers" may be of interest to readers:

The number of adhesives suitable for the manufacture of plywood has increased appreciably in recent years, consequently the user now has a wide range of properties and working characteristics from which to choose. By far the most durable adhesives are the synthetic resin-forming materials which enable manufacturers to turn out a superior type of plywood. Phenol CH_2O resin adhesive, for instance, resists, it is claimed, all forms of deterioration. For hot pressing it requires a high temperature and a fairly lengthy cycle. Where, however, a low temperature is required urea-CH_2O resin is considered to be the better adhesive to employ, and it is making steady progress in its use in such conditions. When mixed with rye or wheat flour urea-CH_2O resin is said to be very economical.

Among Pacific Coast plywood mills soya bean and vegetable protein is largely utilised. Apart from a small quantity of casein, soya bean meal is employed in the manufacture of all Douglas fir plywood, and up to 70 per cent. of soya bean adhesive is used by these mills, according to Mr. Ralph Casselman, research chemist, and Mr. Nils Anderson, Jr., sales engineer, writing in *The Hardwood Record*.

Next to soya bean glue the cheapest and commonest type of adhesive is vegetable starch adhesive, which is suitable for production work, but which possesses little durability. On the other hand, animal glue, the base of which is tapioca or potato flour, is inclined to be somewhat expensive, and is chiefly adopted by mills producing plywood having a high grade face veneer on which stains must not be seen. Scientific investigation, however, has shown that the durability of this class of adhesive is not very good.

Another type of glue, casein, shows good lasting properties when a good formula is utilised. It is most durable when used in the cold press method, and is regarded as a satisfactory adhesive as it resists water in panelling and when used for furniture work.

Finally there is the blood albumen glue, which is obtained from dried beef blood. It is said to be especially suitable for low temperature hot pressing, and is considered to possess more durable properties than all other adhesives except the resins. It can also be used mixed with casein and soya bean glues, and is particularly suitable for the production of special panels.

All wood-bonding materials also have an affinity for water. It has thus become necessary to use soluble materials which bond to wood and then convert them to water-insoluble materials in the wood structure after they have been bonded. This has been done effectively in the new process of forming synthetic resins within the wood structure. A large number of different resin-forming materials have been tried. Of these, phenol-formaldehyde resin intermediates that are soluble in water have been found to give the best and most permanent reduction in swelling and shrinking. The superiority of this combination over others seems to be due to the fact that these chemicals have small molecules that can readily penetrate the structure and that they bond better to the wood.

Messrs. Alfred J. Stamm and R. M. Seborg, senior chemist and assistant chemist respectively of the U. S. Forest Products Laboratory, state that within the last few years synthetic resin glues have been developed that produce joints equal or greater in strength than the wood even under high moisture-content conditions. The glue line of plywood assembled with these hot-press phenol-formaldehyde or urea-formaldehyde glues will withstand rather severe weathering conditions. The wood itself, however, is subjected to such severe

stresses, due to alternate swelling and shrinking of the fibres, that it will eventually fail. As the outer surface of the outer plies is not restrained like the inner surfaces, differential stresses will be set up across these plies and eventually will result in face checking. Because of these stresses, plywood is much more subject to surface checking than a solid board of the same size.

It has been found that applying an anti-shrink treatment to veneer from which the plywood is made not only minimises checking under weathering conditions, but also adds other desirable properties.

RECLAMATION OF THE HOSHIARPUR SIWALIKS

The following note was prepared in December 1938 by F. L. Brayne, Commissioner, Rural Reconstruction, Lahore, on the Reclamation of the Hoshiarpur Siwaliks:

During the latter part of the last century, unrestricted grazing and felling destroyed the vegetative cover of the Siwaliks—a range of extremely friable and unstable hills in Hoshiarpur District. This enabled the heavy rainfall of the locality to bring down millions of tons of sand in devastating floods to the plains below, resulting in the destruction of over 100,000 acres of extremely fertile and valuable soil in an over-populated district with very small holdings.

In 1902, the Chos Act was passed. A rough line was drawn along the range at a short distance above the foot of the hills. Above this line, the hills were closed to the grazing of sheep and goats under Section 4. Below this, unrestricted grazing and felling remained. The idea was that this open area would provide exercise and some grazing for the village flocks.

In nine vallages, Section 5 (complete closure) was also applied to the inner area in a modified form. One-third was closed to all grazing and the other two-thirds were divided into two halves which were open and shut alternate years.

Work continued with varying intensity but reclamation did not keep pace with destruction until after 1934 when a special Forest Officer was attached to the district. He succeeded in getting the people to turn the partial application of Section 5 into the total

exclusion of all livestock, and to apply Section 5 in other villages where only Section 4 hitherto applied. In the plains below the people were persuaded to put a certain amount of devastated land under Section 38 of the Forest Act, thereby enabling the Forest Department to begin reclamation work. In many other places the people have themselves enclosed areas for trees and grass.

What has been the result of all this? Where Section 4 only has been applied, considerable recovery has been made in the hills, but erosion continues and the run-off is still excessive and violent. This, combined with the enormous load of silt and water from the utterly degraded outer slopes—which have had to carry the whole burden of the excluded flocks and herds—has made the reclamation of the plains land below impossible except to a very limited degree. There is no instance where Section 5, either in full or in a modified form, has yet been applied to the whole catchment area of a *cho*, but even where it has been applied to by far the greatest part, the combination of the run-off of the upper reaches with that of the outer unrestricted area, still makes reclamation extremely difficult and only partially possible.

In sections where closure has been complete such as in one branch of Dholbaha *cho* the improvement above the line of closure has been nothing less than miraculous. The hill-sides are clothed with a dense cover of grass, bushes and trees and on the ground lies a mat of vegetable refuse. The ravine water-way has become a narrow channel flanked by wheat fields, fruit trees, bamboo clumps and a luxuriant vegetable growth. Above Dholbaha the wilderness has literally blossomed like the rose, and the Eden-like verdure has to be seen to be believed.

All this has come about without any expenditure whatever on engineering works. In fact, to one who has for years tried to improve things in drier districts, the response of Nature to a little kindness in the Siwaliks is a constant wonder.

That Dholbaha could be repeated in every valley in the Siwaliks, there is not a shadow of doubt, nor is there any doubt that the plains below could in time be completely reclaimed, and inside and outside the hills some 100,000 acres of fertile and badly wanted land could be added to the Province. Throughout the area, both inside and outside the hill area, there are innumer-

able instances of private closures and successful reclamations of land both by private individuals and by the special Forest Staff. Land hunger is intense. The people are alive to the value of closure. They are intelligent, very industrious, and ready to respond to a good lead. They understand the technique of reclamation inside the hills. The amount of digging done and the height of the terraces built to secure a few *marlas* of land are most impressive. Below the hills the problem is more difficult and complicated but given complete closure of the hill area and the guidance of the Forest, Revenue and Co-operative staffs, there is nothing insoluble about it.

Economically, this reclamation work is sound and the people know it. Quite apart from land reclamation, complete closure brings an immediate revenue from hay and from *bhabbar* grass which is used for paper making. Even in this year of short rainfall thousands of maunds of grass are being exported and large areas still await cutting. The stall feeding of milch cattle is well understood. No one dreams of driving valuable cattle to scrounge for a living on the hill-sides. The firs on the north side yield resin, the tapping of which has recently been organised by the Forest Staff.

Much spade work has been done. Sound foundations have been laid by the Forest Department, and the relations of their staff with the villagers are excellent. Things are now ripe for a big forward move by Government and people working together.

There are plenty of difficulties. The interests of landlords and tenants are not always identical, one man's laziness or obstinacy will hold up work for years or spoil efforts already being made by other people. Factions between individuals and parties or between villages make action impossible. Neither individual people nor individual villages can do this work by themselves. A *cho* can only be controlled by the combined efforts of every person and village in the whole area of the *cho* and this can only be secured by Government itself, and Government to achieve this must be ready to coerce individuals or villages when the majority of sufferers in a particular catchment area are ready to co-operate in bringing the *cho* under control.

It is the declared policy of Government to reclothe the Siwaliks with vegetation and to reclaim the devastated area in the *chos*. In pursuance of that policy the following things are now essential:

1. The upper area now under Section 4 must come under Section 5 just as rapidly as can be done without driving the people into non-co-operation.
2. The hill area outside the closure line must similarly come under Section 4 followed by Section 5, as soon as the people will stand it and adjust themselves to the changes it will necessitate in their routine.
3. The plains areas must come under Section 38 of the Forest Act as quickly as possible so that with professional help they may be reclaimed by co-operative societies, partition, or otherwise.
4. The terracing and *watbandi* of all cultivated land in and below the hills must be vigorously encouraged and for this purpose, a system of land revenue remission should be worked out to ensure rapid, complete and permanent land improvement.
5. Where slopes are too steep for terracing, cultivation should be forbidden as soon as the revenue remission system has taken effect and has been thoroughly understood and appreciated.
6. To assist Government in obtaining public support for whatever measures are necessary, surveys should be made:
   (*i*) showing the past and present state of affairs;
   (*ii*) estimating village by village, the acreage upon which remissions should be allowed for terracing and *watbandi* and the amount of land revenue assessed on it;
   (*iii*) estimating the acreage, village by village, which in time can be reclaimed for cultivation both in and below the hills.
7. Only one side of the Siwaliks was gazetted under the Chos Act in 1902. Mr. Glover has reported—and it is only too obvious to anyone looking at it from the watershed—that appalling and increasing devastation is occurring on the other side of the watershed of the Siwaliks and across the

Sohan *nadi* up to the watershed of the next range of hills. The Chos Act must be applied to the other side of the Siwaliks and must be amended to include the Hoshiarpur side of the next range of hills. There is some 50,000 to 1,00,000 more acres of valuable land to be reclaimed here and a vast area of hillsides to be restored to productivity. This area must be tackled in exactly the same way as the western side of the Siwaliks.

8. *Cho* reclamation must be treated as a revenue matter and not a forest matter. The whole revenue staff from Collector to Patwari must learn the technique and use every effort to get it applied. The forest staff is lent to the district to advise and teach and inspect, but the Collector is the steward of the Estate and, with his revenue staff, is responsible to get back the land lost by his predecessors. Junior Assistant Commissioners should be posted to assist the special Forest Officer, and in order to emphasise the revenue aspect of the work the advisability of giving Revenue Powers to the Forest Officer should be considered.

The problem of Hoshiarpur is *mutatis mutandis* the problem of the whole of the Rawalpindi Division and of Gurgaon, Ambala and parts of other districts also. All experience gained and all officers trained in Hoshiarpur will be extremely valuable elsewhere.

NEWSLETTER NO. 18, DECEMBER 1938

Department of Mines and Resources, Forest Service,
Forest Products Laboratories of Canada, Vancouver Laboratory.

As indicated in our last Newsletter in May, the work of the Laboratory has covered an extensive field during the past year. In addition to the studies mentioned, several other problems have required attention during recent months, so that it is impossible to cover all of them in a brief report of this nature. Demands on the staff in the answering of technical enquiries have shown a continued increase, and we believe that this service, which is available to all

interested in the lumber business, has been of marked value in the utilisation and marketing of British Columbia forest products.

A few of the problems which have received special attention and on which information has been assembled in recent months are outlined below.

Mimeographed articles and reports issued include the following:

"Iodine as an Indicator of Sapwood and Heartwood," H. W. Eades;

"The Kiln-drying and Storage of Western Red Cedar Shingles," J. H. Jenkins;

"An Investigation of the Effect of the Type of Case (Wood, Fibre and Corrugated Board) upon the Rusting of Canned Goods during Ocean Shipment," J. H. Jenkins and F. W. Guornsey;

"The Effect of the Shape of the Test Specimen upon its Maximum Crushing Strength," J. B. Alexander;

"Moisture Content of Lumber: Its Determination and effect on Weight," J. H. Jenkins (Revision);

"Recommended Schedule for the Kiln-drying of Certain Species of British Columbia Lumber," J. H. Jenkins (Revision);

"The Properties and Uses of Yellow Cedar," R. S. Perry.

In addition, a further supply of the popular bulletins issued in 1930 by the Provincial Government Forest Branch, on Douglas Fir, Western Red Cedar and Western Hemlock, has been obtained and copies are available at the Laboratory.

The seasoning of 10 large flitches of Douglas fir, Western hemlock, Western red cedar and Sitka spruce, varying in section from 8 by 20 inches to 8 by 48 inches and 16 feet long, has just been completed. This work was carried out for the Department of Trade and Industry of the British Columbia Government, the best of the flitches being intended for exhibit at the San Francisco Exhibition in 1939. Half of the material was placed in a solution of common salt (NaCl) and kept for six weeks at a temperature of 140° F., and then piled for kiln-drying. The remaining pieces were layered with dry salt, which was placed on the top and bottom surfaces, and over the ends of each flitch. After eight weeks, the surplus salt was removed and the flitches piled for kiln-drying.

The kiln treatment in the laboratory dry-kiln consisted of 28 days drying at a temperature of 140° F. with a relative humidity of 90%, decreasing to 80%, using mechanical cross-circulation. The conditioning period was 7 days at 120°F., with a humidity of 72%, followed by 10 days at 85° F., with a humidity of 60%. Very satisfactory drying was obtained.

A special series of runs have been made with the Laboratory charcoal gas-producer unit, in order to determine the relative efficiency of a gasoline stationary engine operating on gasoline and on charcoal gas. Using gasoline, the engine developed 34 h.p. at 2110 r.p.m., with the standard compression ratio of 4.22 to 1. A high compression head with a ratio of 6.76 to 1 was used for the producer-gas runs. Douglas fir charcoal was used and was found to develop only 55 to 70 per cent. of the power with gasoline. The tests indicate that for satisfactory performance, under heavy load, an over-powered engine should be installed when charcoal producer-gas is to be used.

In order to study the relative efficacy of certain chemicals in preventing sap stains and moulds in lumber, a test pile was erected at a local mill some time ago, including Western white pine, Western hemlock and Douglas fir which had been dipped in several different commercial sap stain preventives. This pile was first dismantled in July last when the extent of sap stain and mould on each piece was carefully noted. The pile was re-erected in reverse order and finally dismantled in September and all boards were again carefully examined. A report on the study is now in course of preparation.

At the request of the Research Committee of the Association of Marine Underwriters of British Columbia, an investigation into the effect of the type of case on the rusting of canned goods during ocean shipment has been undertaken by the Laboratory. Due to lighter weight and attractive appearance, fibre board cases have, to a large extent, replaced the wooden box for certain uses in the past two or three years, but certain marine surveyors and shippers are of the opinion that rusting is more extensive in the fibre cases and cans are more liable to crushing than in wood. Considerable

information on the subject has been collected and assembled in a progress report which has been reprinted by the Research Committee of the Association of Marine Underwriters of British Columbia and is available upon request.

Shear tests on a limited number of test sections of Douglas fir and hard maple, glued up with a new cold press liquid, synthetic resin glue, showed 90% wood failure in the Douglas fir and 100% wood failure in the maple test blocks. Glued up sections of Douglas fir three-ply showed no separation of the plys after immersion in water for 30 days, nor after exposure to dry heat at 212° F. for same period. Sufficient tests have not yet been made with this glue to express an opinion as to its merits, but from the studies made it appears to offer prospects for satisfactory use.

Comparative strength tests on small, clear test sections from a shipment of Douglas fir from the Interior Wet Belt have recently been completed and results are being summarised. Similar tests on a shipment of Douglas fir from Cowichan Lake are in progress. When completed the results of tests from the various shipments will be analysed to determine any possible effect on the properties of the wood attributable to area and the extent to which density may serve as a measure of the comparative properties.

The study of the holding power of nails in various commercial species of British Columbia timber has been continued and has made available a great deal of information on the use of different sizes of nails of varying types with Douglas fir, Western hemlock, red cedar, yellow cedar and true fir.

Tests are nearing completion on pink or purple stained Douglas fir to determine what effect this streaky heart has upon the normal strength of the wood and whether it represents a condition in the wood whereby it is more subject to decay than unstained material. Analysis of a great many tests is under way, and it is expected that a report covering the study will be available in the near future.

Several interesting tests were recently carried out on some Douglas fir flush doors. The load in diagonal compression carried by these doors was, in every case, much greater than the load on similar dowel or mortise and tenon doors.

Many problems of a minor nature have also been dealt with in an effort to improve the handling and use of British Columbia woods. Some of the more interesting of these investigations include:

The cause of cupping in red cedar bevel siding; the cause of honeycombing and internal checking; methods for improving the drying of Western hemlock; the cause of variations in the size of Western hemlock; drying of thick Western white pine; conditioning yellow cedar Venetian blind stock; drying flooring blocks; heartwood colorations in Western red cedar, etc.

Sample material of British Columbia woods considered suitable for the manufacture of butter boxes has been sent to our Ottawa laboratories where tests are in progress, in co-operation with the Dairy Division of the Department of Agriculture, to determine the relative tendency to tainting of butter packed in these boxes.

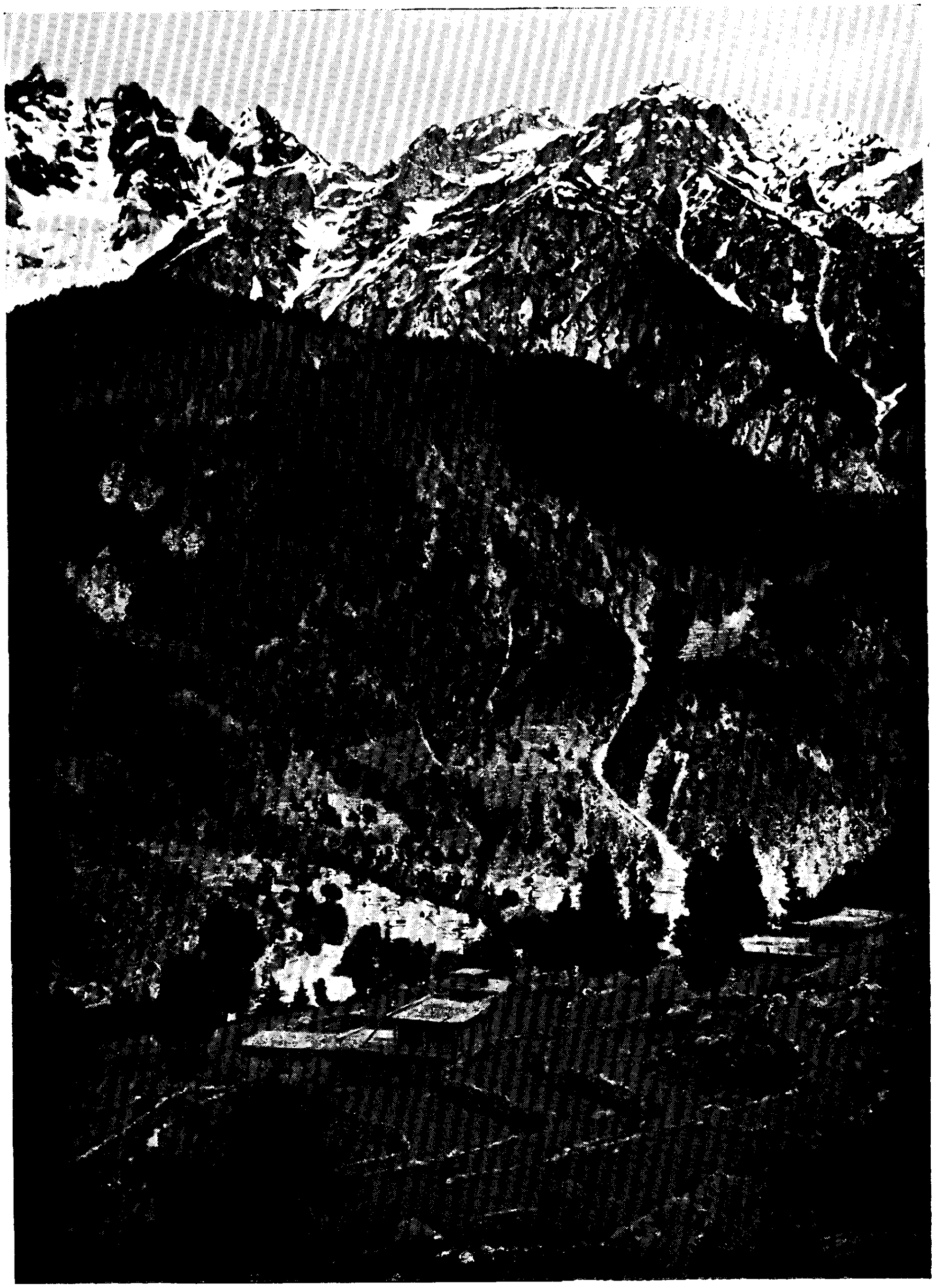
The following information is taken from the accounts relating to the *Seaborne Trade and Navigation of British India* for January 1939 :

IMPORTS

ARTICLES	MONTH OF JANUARY					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
Siam ..	40	189	43	3,466	24,761	5,420
French Indo-China	..	100	144	..	13,761	14,914
Burma ..	..	*13,403*	*10,128*	..	*17,64,841*	*12,94,231*
Java ..	352	761	481	35,524	99,859	54,909
Other countries ..	..	25	16	..	3,232	2,609
Total ..	392	14,478	10,812	38,990	19,06,454	13,72,083
Other than Teak—						
Softwoods ..	404	1,893	1,348	24,862	1,44,837	85,832
Matchwoods ..	1,563	1,002	758	90,547	57,722	43,829
Unspecified (value)	..	..	..	42,940	3,86,611	2,23,543
Firewood ..	31	76	42	465	1,140	635
Sandalwood ..	12	..	5	8,738	247	2,533
Total value ..	..	..	..	1,67,552	5,90,557	3,56,372
Total value of Wood and Timber ..	..	..	..	2,06,542	24,97,011	17,28,455
Manufactures of Wood and Timber—						
Furniture and Cabinet-ware ..		No	data	No	data	
Sleepers of wood ..	..	21	46	..	1,336	5,190
Plywood ..	385	648	605	90,119	1,47,709	1,12,768
Other manufactures of wood (value) ..	..	..	..	1,41,596	2,43,379	1,42,659
Total value of Manufactures of Wood and Timber other than Furniture and Cabinetware ..	..	..	..	2,31,715	3,92,424	2,60,617
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	33,164	9,102	28,001	2,14,522	91,737	2,71,036

EXPORTS

ARTICLES	MONTH OF JANUARY					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1936	1937	1938	1936	1937	1938
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	3,904	..	10	8,30,405	..	1,250
,, Germany ..	748	..	..	1 50,797	..	..
,, Iraq ..	18	13	8	2,136	880	1,660
,, Ceylon ..	87	3	..	10,107	120	36
,, Union of South Africa ..	449	..	..	80,508	..	..
,, Portuguese East Africa ..	184	..	..	31,942	..	..
,, United States of America ..	55	..	..	16,559	..	..
,, Other countries	253	115	25	53,932	29,509	6,980
Total ..	5,698	131	43	11,76,386	30,509	9,926
Teak keys (tons) ..	485	..	..	66,970	..	..
Hardwoods other than teak ..	110	..	2	11,048	..	350
Unspecified (value)	..	..	..	93,844	70,855	18,488
Firewood ..	6	51	..	80	700	..
Total value ..	..	..	..	1,71,942	71,555	18,838
Sandalwood—						
To United Kingdom	..	3	2	..	3,350	2,200
,, Japan ..	5	11	2	5,000	13,070	2,250
,, United States of America ..	..	103	7	..	1,11,775	3,900
,, Other countries	14	27	22	15,265	27,192	20,945
Total ..	19	144	33	20,265	1,55,387	29,295
Total value of Wood and Timber ..	..	..	..	13,68,593	2,57,451	58,059
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	12,035	28,093	57,283
Other Products of Wood and Timber		No	data	No	data	



Deodar Forests—Swat Kohistan. *Photo: H. L. Wright.* *(Copyright)*

INDIAN FORESTER

MAY 1939

FORESTRY BEYOND THE INDUS

BY H. L. WRIGHT, I.F.S.

I.—GENERAL

During the last two years—1937 and 1938—I was particularly fortunate in my touring. Not only was I able to see most of the important forests in the tribal territory of the North-West Frontier Province, but also had the opportunity of visiting Gilgit and of seeing forests that had not previously been inspected by any forest officer from India. This visit, which was made during two months' deputation to the Department of External Affairs, was particularly lucky as it enabled me to round off my experience of the Western Himalaya and Hindu Kush and to obtain a brief acquaintance with part of the Karakoram and so to complete my knowledge of the forests beyond the Indus.

Forestry on the frontier side of the Indus river is still in its infancy for, previous to 1931, the Forest Department in the North-West Frontier Province functioned only in the cis-Indus district of Hazara. But, in 1927, a special Conservator, Parnell, was appointed in the Province to inspect and report on the forests of the trans-Indus districts and agencies and, as a result of his labours, the Province was, four years later, formed into a circle of conservancy, and a new division created to deal with forest activities beyond the Indus.

This Division, Peshawar, must be one of the most extensive forest divisions in India, for it stretches from the Hindu Kush in the north almost to the borders of the Sind Desert in the south. But it contains very little Government-owned forest: only a scrub reserve of about twenty square miles in the Peshawar District; the Cherat Cantonment Forest, which is managed for the Defence Department; about ten square miles of unclassed "Rakh" on the banks of the Indus in the Dera Ismail Khan District, and some

hundred and twenty miles of canal-bank shisham avenues, along the Lower Swat Canal, which are managed under a sanctioned working plan for the Public Works Department. The chief importance of this Division, however, lies across the border, where it is responsible for whatever forestry is possible in the trans-Frontier Agencies.

And here it may be as well to explain how it is that any forest control can be exercised outside the settled districts. To begin with, it must be realised that, across the Indus, the plains are generally in British India, while the hills beyond lie in tribal territory. Tucked away in these hills are considerable areas of valuable forest, covering the catchment areas of the rivers which feed the provincial canals. The preservation of these forests is thus a matter of national importance, for disforestation in these hills would inevitably react on the water-supply, with disastrous results to cultivation in the plains of British India.

Before the advent of the Forest Department uncontrolled fellings had been taking place for years in many of the tribal highlands, particularly in the side valleys of the Indus and in Dir and Swat States, and one of the first activities of the Department, after extending beyond the Indus, was to assume control of the main rivers and to introduce rules to regulate the floating of timber. At the same time, an import duty was imposed on all timber entering British India from tribal territory, the duty being pitched high enough—four annas a cubic foot on logs and eight annas a cubic foot on scantlings—to make a big hole in the profits from this industry.

The object of the duty was not, however, to kill this trans-Frontier timber trade, but to bring it under control, and forest owners were assured that, if they allowed their forests to be brought under management, the duty on the timber exported from their estates would be merely nominal, just sufficient in fact to reimburse Government any expense that had been incurred on the owner's behalf. The Wali of Swat was the first of the trans-Frontier rulers to accept this offer and to place his forests under the technical control of the Forest Department, an action which he can have had no cause to regret as his forest estate is now managed under a regular working plan and produces a substantial annual income without depreciating its capital value. Chitral State, too—although not yet aspiring to a working plan—employs a forest officer to mark

Typical Trans-Indus, low hill forest—Olive and "Phulai," and very poorly stocked.

The District Forest Officer, Peshawar, with the armed Forest Khassadars in the Kurram Agency.

Photo: H. L. Wright.
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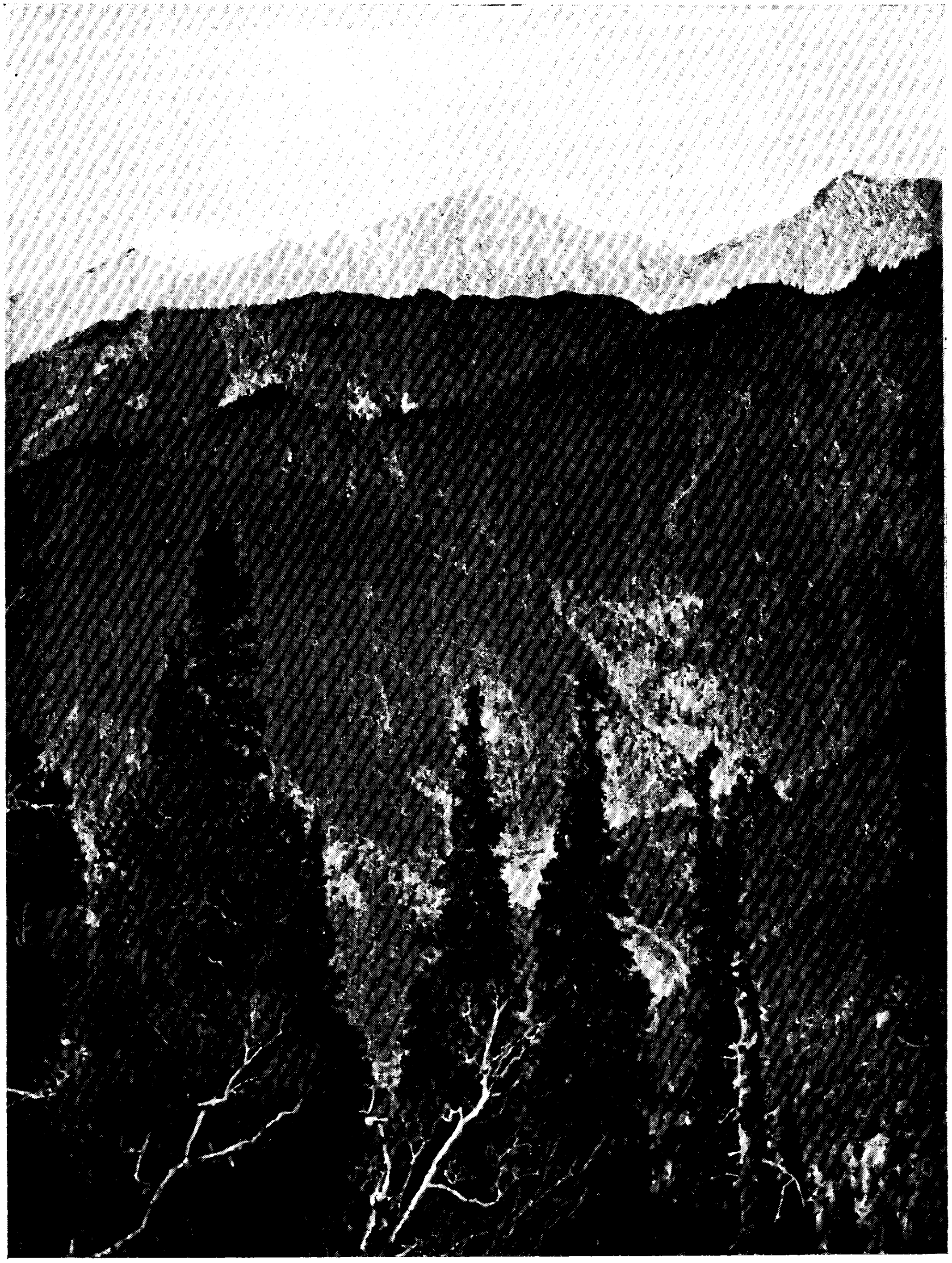

The forests on the Sufed Koh, the boundary of the Kurram Agency and Afghanistan.
Photo: H. L. Wright.
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the trees and to supervise the purchasers' operations, but the Nawab of Dir, the third of the States in the Malakand Agency, has remained adamant, and has steadfastly refused either to have his forests inspected or to permit any form of control. As a result, his estate remains unworked.

In the Indus Valley, the valuable Kohistan deodar forests are owned by village republics, over whom but a nebulous political control is exercised, and so far it has not been possible to arrange for anyone to inspect these forests, but here the heavy duty is slowly taking effect and imports from this territory are steadily falling off. Lower down the Indus Valley, in the tribal territory bordering the Hazara District, the Khan of Hillan recently asked for his forests to be inspected. A Forest Ranger was sent to report on the forests and, as a result of this inspection, permission has been given for the sale of trees for export, the markings and the supervision of the purchasers' work being carried out by the Forest Department. Thus, little by little, control over the more important forest areas is being extended.

Further west, in the Kurram Agency, about five square miles of deodar forest, lying along the boundary with Afghanistan, have been brought under direct control and are managed under a working plan on behalf of the local people, but in Waziristan, where serious disforestation took place in the early days of the occupation to supply the garrison with firewood, all attempts to introduce forest conservancy have met with failure, although disforestation has been checked by insisting on the troops using oil instead of firewood for cooking. But even here the Forest Department is not inactive. A Forest Ranger is stationed at Razmak, and manages a large nursery in which fruit trees and other plants are grown for distribution to the tribesmen. Even during the disturbances of the last two years, from ten to fifteen thousand plants were given away each year, and it is perhaps a mark of appreciation of what the Department is doing that no attempt was made to damage either the nursery or the pipe line leading to it, although both are well away from the protection of the camp.

In the settled districts, there is little that can be done. As Parnell pointed out in the report written at the end of his visit, forest conservancy arrived fifty years too late. All the State "Rakhs"

have been inspected and reported on, but most of them are in such a state of degradation owing to excessive grazing and illicit fellings that there is little hope of ever bringing them back to a state of productivity. There are, however, a few small areas which are worth preserving, and these are gradually being reserved under the Indian Forest Act. The best of these, Khawara in the Peshawar District, was reserved in 1933, and has, as the result of protection, shown enormous improvement. So, too, has the Cherat Cantonment Forest, the management of which was taken over at the same time. Here the olive trees have put on remarkable growth since lopping and felling have been stopped and now have the appearance of trees rather than of stunted bushes; soil conditions have improved and grass now grows where before there was none; the station water-supply has increased and after many years water has again appeared in the swimming pool. Thus, even in an arid and desolate tract like the Frontier Province, forestry can, if applied in time, add to the amenities of life and save the country from complete destruction.

(*To be continued.*)

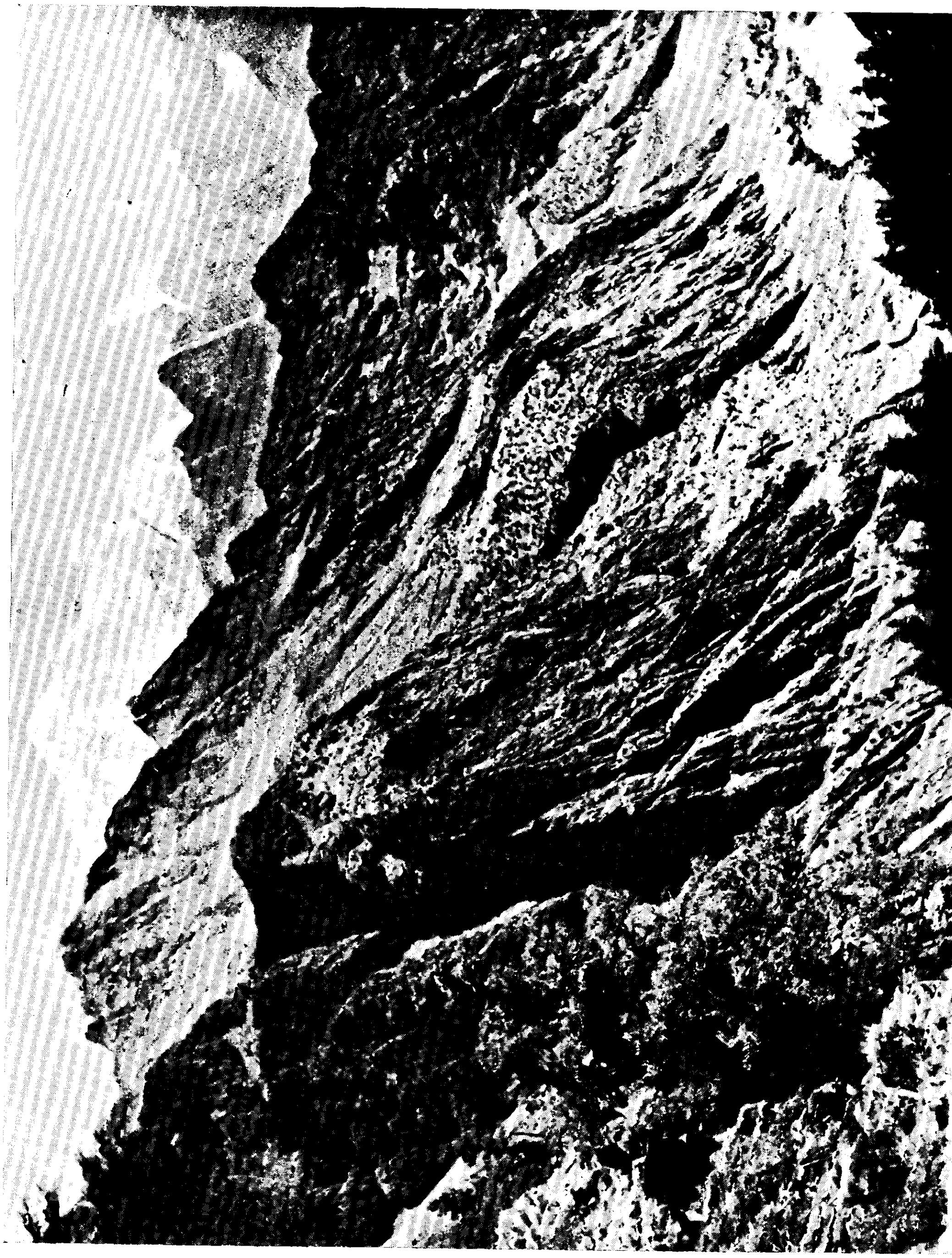
CURRENT PROBLEMS IN EROSION CONTROL

By R. Maclagan Gorrie, d.sc.

Punjab Forest Conference, February 1939.

In the following notes on local experience in erosion control in one district, I hope to be able to interest forest workers throughout the Punjab and the Frontier Province. As in warfare, so in the use of the soil, no general advance can be made unless and until a salient has been made at some particular point and a footing obtained at this place in the enemy's line. I regard Hoshiarpur District as the "Cambrai Salient" of our war against soil waste, because there we are dealing at close quarters with many different aspects of the problem, and whatever succeeds there can later be employed on the wider front of the foothills as a whole.

A striking change in the point of view of our civil administration has occurred within the last few years. The Forest Department was previously regarded as a police force for the protection of the very small area of reserved forests (six per cent. and three per cent. of the land area of the Punjab and Frontier respectively). Now,



In the Karakoram, north of Gilgit—a little spruce and scattered juniper. Rakaposhi, in the background.

Photo: H. L. Wright.
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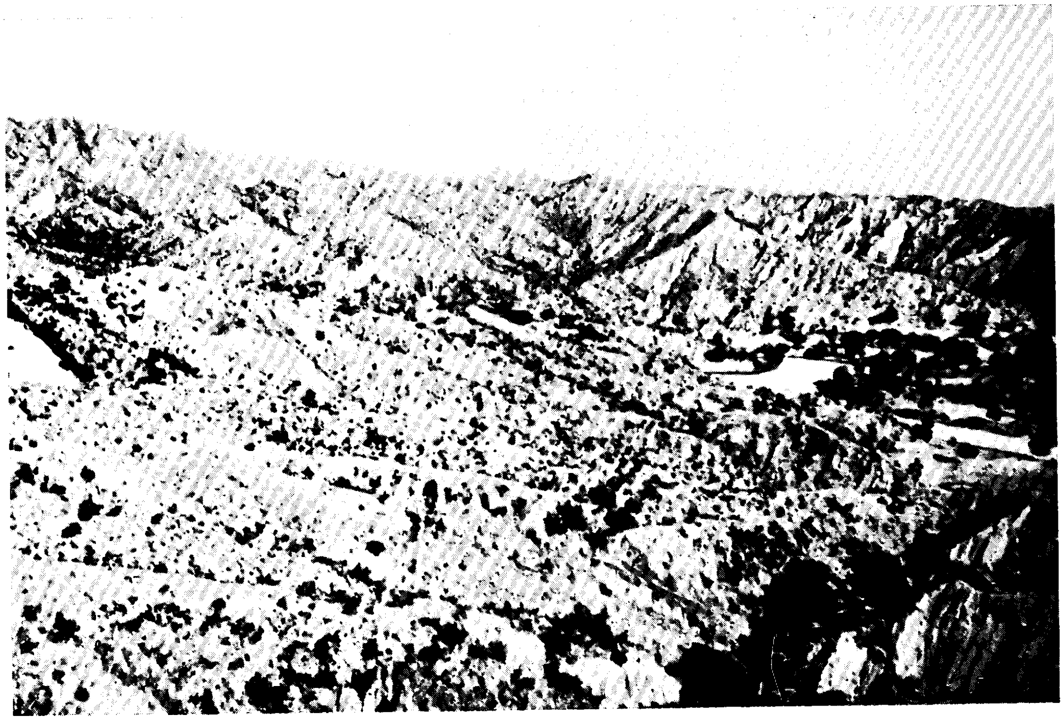


Village lands in the Sohan Valley, not yet brought under the Chos Act. These slopes are now about as bare as the outer face of the Katardhar was 50 years ago when destructive utilisation was at its worst.

Head of Lalwan village lands, showing effect of 2 years of closure on land previously eroding hard.

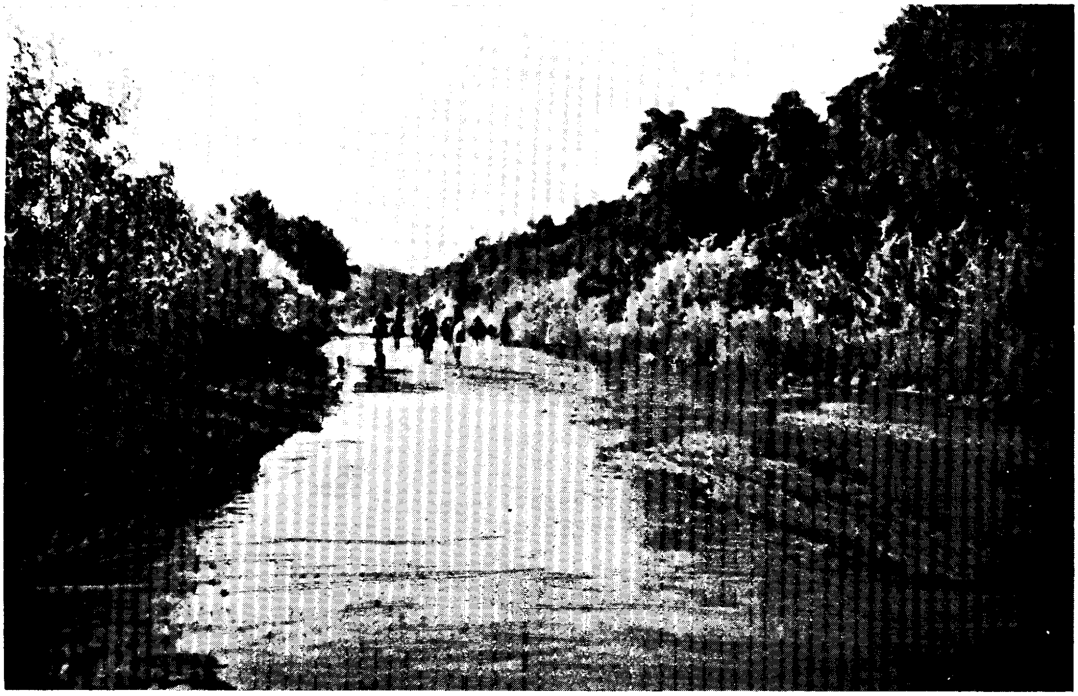
however, our administrators are beginning to appreciate that they possess in the forest department a body of scientifically trained men who can contribute effectively to the better management of the country as a whole, whether in hills or plains, whether owned privately or in common holdings, whether under farm crops, grazing grounds, forests or uncultivated waste. As opposed to the agricultural experts for crop diseases, seed improvement, fruit culture, etc., with their very specialised knowledge of one branch of land use, the forest officer can contribute a valuable knowledge of plant behaviour and the processes of degradation as produced by the action of man and his animals upon the natural plant cover. The value of this outlook in connection with the provincial soil erosion and water supply problems is only now being appreciated and put to practical use by the civil administration. In the areas where forest reserves exist, the old "policeman" attitude with its bitterness and suspicion still persists, rendering any constructive advance in land management exceedingly difficult to introduce. It is in areas such as the Katardhar of Hoshiarpur where the villagers own the hill lands and have only themselves to blame for the destruction of the protective forest mantle, that a constructive policy of planned land use stands a better chance of success because the villager there is prepared to accept the forest officer as a friend and not as an enemy.

Working of the Chos Act.—The Punjab Land Preservation or Chos Act of 1900 was framed to provide for the better preservation and protection of parts of the Punjab "situated within or adjacent to the Siwalik mountain range," but was in the first instance applied only to the outward slope of the Katardhar, as the main Siwalik ridge is called in Hoshiarpur and Ambala. Unfortunately in Hoshiarpur the lower boundary of this notified area was demarcated by a line which runs not along the foot of the hills but some distance back from the plains. This was a serious mistake as it has exaggerated the grazing damage which is inevitably greater along the foot of the hills, and the goats and other livestock evicted from the closures above have concentrated in this lower fringe with the most disastrous consequences. Even where closures above have materially reduced the burden of sand brought from the upper hills by the torrent, the amount of sand carried down from this eroding lower fringe will continue to damage plains property and render the stream

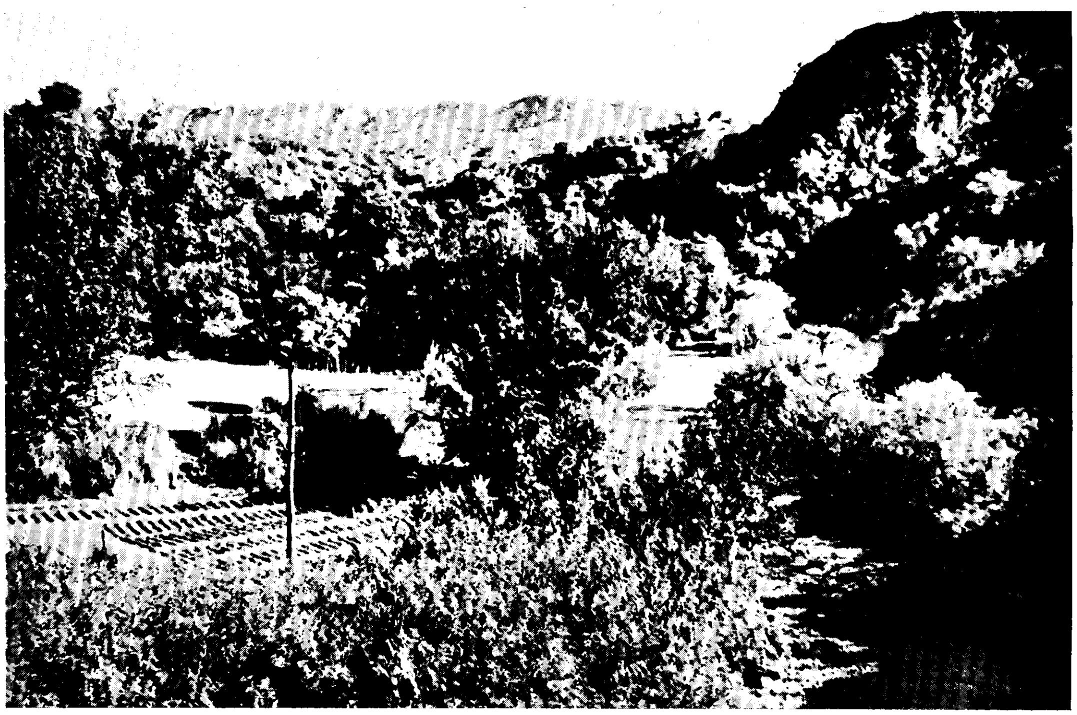
regime unsteady and dangerous, thus greatly reducing the value of some very fine constructive reclamation work which has already been done in the cho beds where these are still hemmed in by the hills.

On the outward or western slope of the Katardhar nine villages were forced to close part of their catchments aggregating 8,500 acres to all grazing in 1905, but the rest of the notified area was merely closed to goats and camels and left open to other livestock. The improvement in cover thus effected throughout the western slope, together with subsequent more effective closures resulting from Messrs. Allahyar Khan and Hamilton's propaganda and from the partition of *shamlat* to form private hayfields, are, together, responsible for a gradual improvement in run-off. On the outer slopes the closures now amount to 32,500 acres under Section 5, about as much again under private *baggal* or hayfield closures, 6,000 acres of *bela* land closed below the hills, beside over 90,000 acres closed to goats under Section 4 by the original Act. It has been stated in previous papers that the destructiveness of the *chos* reached a climax in the 1890's but it has not been sufficiently emphasised that the improvement since then is due to these protective measures.

On the inner or eastern slope and the Sohan valley beyond, the Chos Act was not applied in 1902, as it was then considered to be sufficiently well forested. Since then, however, the pace of destruction has increased until to-day many of the Sohan Dun villages are being disforested as completely and as disastrously as were the outer slopes 50 years ago, when 300 boat-loads of fuel a day were being shipped across the Sutlej for the canal and railway development. Mr. Hamilton's propaganda work of the last few years has, however, borne good fruit and the more intelligent villagers are now clamouring for government action in enforcing the closures they have asked for. Unfortunately, the gazetting of a notification under the Act takes much time. Maps of all the *khasra* numbers of fields have first to be prepared and it is only recently that any special staff of *patwaris* has been provided for this work. When the maps have been checked by the revenue department the papers have to go through the offices of the legal remembrancer and the financial commissioner. There has thus been a lag in some cases of over 2 years between the

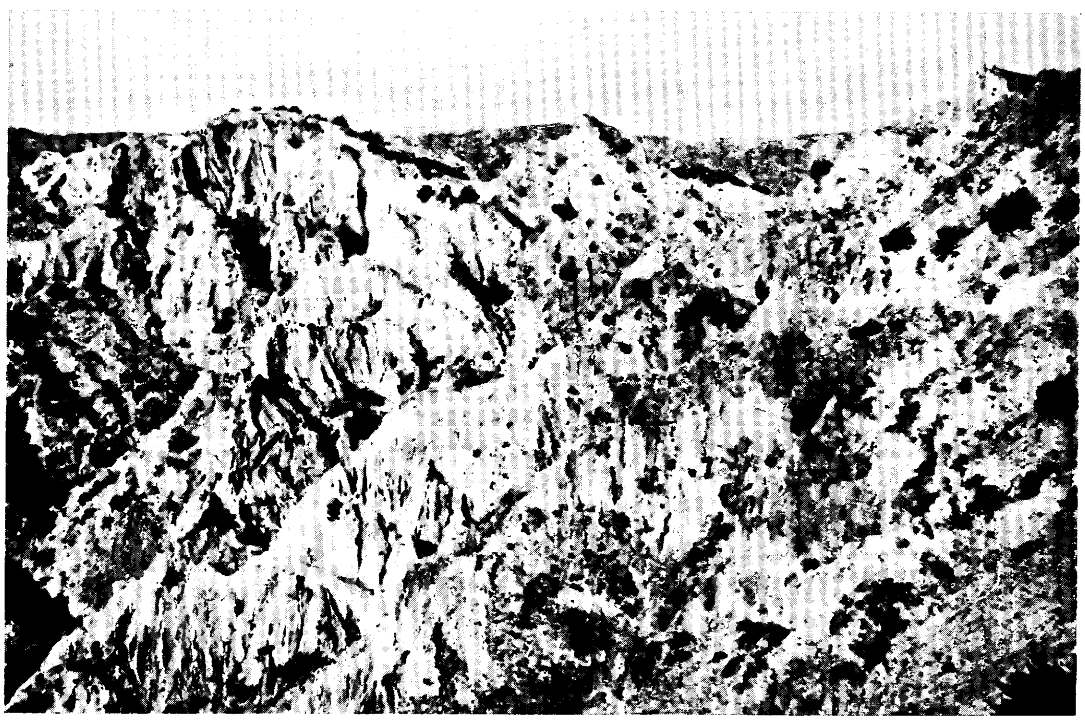


Kukanet branch of Dholbaha Cho: reclaimed fields on both sides of permanent water channel.



A fully reclaimed cho bed belonging to Nari village. Hay fields on the slopes above have reduced the torrent so that flat lands along the river-side have been turned from a waste of sand into fertile fields, protected from being washed away by dense hedges.

Good loads of bhabbar grass at 12 annas a maund being carried to Hoshiarpur and thence to Jagadhri Paper Mills. Product of Chos Act closures which have allowed this grass to grow on land previously destroyed by grazing.



The head of Lambawala branch of Maili Cho, suffering from severe gullying due to constant heavy grazing of outside cattle from Dumsua admitted on payment by Maili landlords.

receipt of the application for closure signed by the necessary two-thirds majority of the landlords and the issue of the gazette. In the interval all the dissentient voices in the village, including the inevitable opposite party of landlords, and the tenants as a whole, have seized upon this opportunity to work up a stronger opposition, and to get what they can in the way of quick returns before closure is applied. Particularly in the villages where the Rajput landlords have failed to control their Gujar tenants, the Gujars from their hill-top *abadis* have completely destroyed large areas of forest. By felling and uprooting the scrub jungle they make a revenue of possibly Rs. 4 per acre, then they sow the unterraced land with gram and get one good crop of it, yielding at the most Rs. 2 per acre. By next harvest season sheet erosion has removed most of the top-soil and the area is not worth sowing, but, unfortunately, it does not then revert to jungle but remains open to grazing until it becomes a scree of loose stones.

We are trying to have Section 3 of the Chos Act applied as a general measure to the whole of the inner face of the Katardhar, as this would give us effective control throughout the area. The piece-meal closure of certain villages following a two-thirds majority application has up to date (December 1938) given us complete closure to grazing over 4,600 acres and eviction of goats from 13,500 acres in the Sohan Dun, while a further 20,100 acres of chil forest is under control as far as the tapping of resin is concerned. There still remains practically the whole of the 450,000 acres of Una tehsil in the catchment of the North and South Sohan Rivers in which some form of run-off control or cho reclamation is badly needed before we can make any serious contribution to the canal engineers' problem of winter water shortage in the Beas and the Sutlej. I have calculated that the two Sohan Nadis contribute about five million tons of sand a year to the Sutlej river system.

Choice of Chos Act or Forest Act and Voluntary versus Compulsory Closures.—In arranging voluntary closures as a means of reclaiming denuded slopes or torrent beds we have the choice of Section 5 of the Chos Act or Section 38 of the Indian Forest Act, the chief difference being that the Chos Act is permanent while the Forest Act can be for a specified period of years. The latter appeals to the

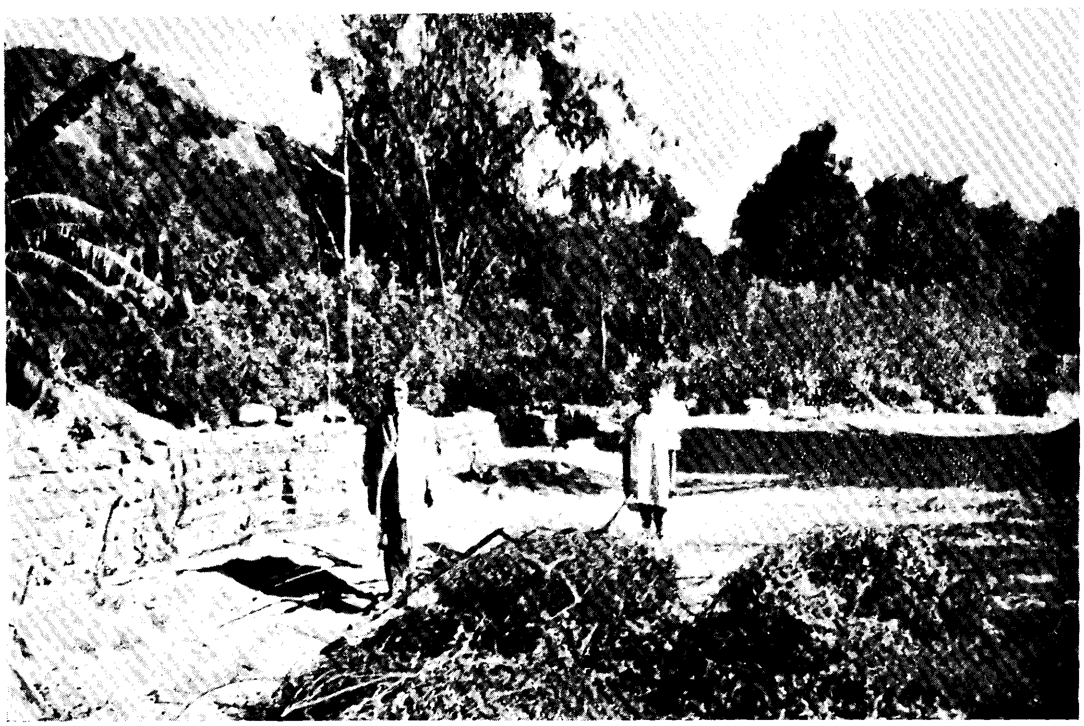
landlord as being a less complete surrender of his *ownership*. Actually in neither case is ownership given up because the area is only handed over to Government control as regards *management* of the estate, the rights and revenue being secured to the owners. In the hilly tracts of the Siwaliks the Chos Act is preferable to the Forest Act, because eviction of goats is ensured. In the *bela* lands below the hills where *cho* reclamation work is now rendered possible by torrent control upstream, either Act can be employed because the Chos Act has not so far been applied to these lands as a general measure.

Under its preamble the Chos Act is applied to the Siwaliks only, so that it can be applied to the main Himalayan foothills or other sloping lands in the province only by a specific extension of the act. Where this cannot be made, the only alternative method of closure is through Section 38 of the Indian Forest Act. In either case a two-thirds majority of the owners must be obtained in order to apply voluntary closure. In reviewing the work to date in Hoshiarpur, it is clear that the four years devoted to intensive propaganda since 1934 have been a very sound investment from the government point of view, because even where the amount of voluntary closure has been disappointing, the community is now so impressed with the need for conservation that it is prepared to accept with a good grace whatever compulsory measure government decides to bring in, whereas four years ago any attempt at compulsory closures would have met with very violent opposition.

The need for educating the zamindar to understand his own obligations has not been appreciated in the past, and the failure of the Rawalpindi *guzara* forest management can be blamed very largely upon this omission. One should not give a schoolboy a motor-cycle to ride before he has been taught that petrol is a dangerous explosive.

A serious objection to the application of compulsory closure under either of the Acts is that it renders government liable to pay compensation for the eviction of humans or livestock. In the early closures in the Katardhar a ridiculously high figure was paid, namely, Rs. 4 per head of goats which were merely moved from one side of the watershed to the other or into adjoining level lands to continue

"Nal" and "Muggar" bamboos, grown by Bah Lakhan villagers in their own lands in Dasuya tahsil, are selling for four and five annas a piece. A single offset planted will yield a total of about 30 pieces within 10 years.



An enterprising ex-soldier, Jamadar Diala Ram of Nari, has made a garden out of a desert by saving land from the bed of Chohal Cho and planting it with bananas and bamboos. He says this would have been impossible a few years ago and is only possible now because the force of the torrent has been lessened by protection upstream.

the work of destruction near-by. Unfortunately, the assessment of such compensation as governed by the Land Acquisition Act is liable to be very high, particularly when small tracts are thus taken up in piecemeal sections and the same animals or their progeny have to be evicted repeatedly as the area under the Act is extended.

From the zamindar's point of view, compulsory closure and the acceptance of compensation is a thoroughly bad bargain compared with voluntary closure. Under voluntary closure, his rights are fully assured and he quickly makes up more revenue from cut grass than he loses in grazing value. Under compulsory closure, on the other hand, the acceptance of compensation debars him from the exercise of rights or the realisation of revenue from the land for whatever period the closure is to be enforced.

Cho Reclamation as one of Co-operative Societies' Activities.—The Punjab Erosion Conference of 1936 passed a recommendation for the appointment of co-operative societies' special staff to organise cho reclamation, but it was not until November 1938 that appointments were made of an inspector and six sub-inspectors to Hoshiarpur and an inspector and four sub-inspectors to Ambala. These men have been given a week's teaching in cho reclamation work and have been posted to various parts of these districts to carry out propaganda and start societies wherever they can. Hoshiarpur is already about the best district for co-operative credit banks and other forms of co-operative work so that within the framework of their own department these men should be able to get a lot of valuable help from the influential members of existing societies and unions.

Previous attempts to organise societies for cho reclamation have not been a great success, largely because the societies were used as a fence with which to avoid closure under the Chos Act and keep away the Katardhar forest staff. For instance, Maili village possesses the third largest holding of hill land of all the west-slope villages—4,150 acres beside an additional 1,100 acres of uncultivated land outside the Katardhar line. In virtue of this it should have been amongst the first to appreciate the value of efficient closure as guaranteed by Section 5, but instead the society has clung to the exercise of its own authority without any backing from the Chos Act with the result that its revenue from grass sales per acre of holding

is very poor indeed, and the catchment area as a whole is in a lamentably bad condition as compared with the adjoining Section 5 closures in Bachhoi and Lalwan. There is, however, a good future for cho reclamation societies if they can be persuaded to accept the guidance of their co-operative societies' officers as regards the book-keeping and co-operative side of their work and of the forest staff in the technical side of cho reclamation. Provided reclamation starts at the top with efficient closures and is followed downstream with a series of small check-dams in suitable places to break the force of the torrent in each considerable branch nala, a large area in each cho bed can be reclaimed for cultivation and the narrow parts can be made productive with bamboos, *harar* trees, santra oranges and other fruit and timber. The banks of the reclaimed fields can also be made very productive by planting revenue producing species as soon as the pioneer hedges of *nara* reed (*Arundo donax*) and *banha* bush, (*Vitex negundo*) are doing their work of embanking the flood channel. Much of this work can be done far cheaper on a community basis of labour contributions than it would in any other way, and the profits accruing should therefore be correspondingly better.

Once the stream within the hills has been brought under control, the outlying *bela* lands, now a sandy waste, can be made fully productive with crops of *kharkana* grass (*Saccharum munja*) and shisham trees and when the stream has been confined to a more permanent bed by a course of stream-training work, much of the reclaimed land can be brought back into cultivation. This has, of course, been frequently done already in the past, but the unco-ordinated efforts of individuals have been beaten by the greed which allows the felling of the protection belt of dense vegetation, which must remain always necessary if the stream is to be confined to a permanent channel. Co-ordination of effort is essential if such attempts are to be permanent, and some form of official supervision is needed to secure this. The ideal organisation is of co-operative societies which can depend upon the support of revenue officials and the technical advice of the forest officer as well as their own officers' supervision.

The Role of Afforestation in Cho Reclamation Work.—Although the main object of the Hoshiarpur closures has been to obtain grass where previously no grass was allowed to grow, we should not lose sight of the fact that trees and bushes are definitely superior to grass

in controlling torrential run-off. Recent data from American measurements such as those of H. G. Meginnis at Holly Springs, Mississippi, for sandy foothill country with a climate not unlike Hoshiarpur, show the enormous increase in absorption in quite young tree plantations of *Robinia.* The actual accumulation of a humus layer showing colour variation in its soil profile is apparently not an essential feature; tree crops increase the porosity by rebuilding the lost "crumb structure" of the soil long before any alteration in profile colours is evident.

The Siwalik hills in Hoshiarpur district alone occupy something like 1,000 square miles and the sloping lands north of the Sohan another 300 square miles, much of which is now devoid of tree growth altogether. The cost of replacing the tree crop over such large areas is prohibitive and we are forced to wait for many years while nature carries out the work in her own leisurely and haphazard fashion. In the small areas where tree sowings have been made, the deficient monsoons of 1937-38 have played havoc with the earlier sowings and casualties have been heavy even amongst five and six-year old plants established on bare slopes. Of the many species tried even the local *kikar* (*Acacia arabica*) and *beri* (*Zizyphus jujuba*) and the exotic mesquite (*Prosopis juliflora*) all previously passed as hardy, have disappointed under this year's severe test and we left with only two really reliable species, namely *phulai* (*Acacia modesta*) and *khair* (*Acacia catechu*). Wherever tree sowings are justified at all, I consider it is essential to spend a little extra in making contour trenches instead of patch sowings on the slope. The extra moisture caught and stored underground by carefully levelled contour trenches is of enormous value in giving the young trees a good start.

Individual villagers make a very good revenue from their clumps of *nal* and *muggar* bamboos (*Bambusa nutans* and *arundinacea*), and these together with the *bainj* (*Dendrocalamus strictus*) should be planted much more commonly along the *cho* beds within the hills. They fulfil ideally the double rôle of giving a reasonably quick cash return together with a grand contribution as an effective barrier against torrent action. A single clump of *bainj* can block a small gully so effectively that a level terrace of silt is formed behind its own roots.

The use of shisham as a means of reconditioning sandy land in the *belas* below the hills has not been fully appreciated. Much of the *bela* lands formerly very fertile have been buried by torrent action under a deep mantle of sand. This can be made fit for field crops after shisham and *kana* grass have been growing on it for 20 years, but after a few years of field crops the sand again becomes impoverished through lack of proper manuring. It would be in the villagers' best interests if we could persuade them to adopt a rotation of forest and field crops in which 20 years of shisham and *kana* grass alternates with 12 or 15 years of field crop.

Technique of Cho Training inside the Hills.—Experimental work during the last few years on the training of sandy torrents tends to confirm the opinion that expensive bunds should be avoided. Instead we prefer to use hedges of *nara* and *banha* plants aligned in the *cho* bed so as to deflect the main force of the torrent gradually into the desired direction and away from strategic points where it threatens valuable land. A better run-off regime upstream means that the torrent is year by year bringing down less sand and the peak of the flood is also becoming gradually less. The waste lands below can best be tackled for constructive planning and reclamation when plant recovery has begun, and it is in fact perfectly useless attempting it under any other circumstances, because the vagaries of a *cho* with an increasing load of sand and greater flood peaks are quite impossible to control effectively and permanently.

The rôle of the *nara-banha* hedge is to comb out the floods which flow over it, slowing up the water so that it drops its load of sand and silt. This helps gradually to raise the level of the ground around the hedge and it is astonishing what a lot of sand can be trapped by a parallel series of hedges set at an obtuse angle of say 165 degrees to the direction of flow. The *nara* roots and *banha* branches are buried fairly deeply in trenches about February and with any luck a large percentage will have struck root before the monsoon floods occur in July, and the hedge is thus immediately effective as a comb. In the more arid climate of Gujrat and Jhelum it is doubtful if a sufficient percentage of sprouting can be obtained to justify spring planting, so that monsoon planting of hedges is probably safer.

The roping operation. A "mahout" can be seen tying a rope round the neck of a wild elephant held secure between two "kumkis."

Escorted by four stout "kumkis," the wild elephant is led away from the stockade.

It is often difficult to avoid being committed to the building of expensive bunds where a town or village is suffering damage and asks specially for help. It is also a fact that the building of a spectacular piece of work like a bund appeals much more strongly to the layman than does the slower but more effective *nara-banha* hedges. Only where the upper catchment area is in a foreign state and thus beyond practical control are expensive bunds justified and even here they are liable to cause disappointment as has occurred in Gujrat District. The best example in Hoshiarpur is that of Bachoi Cho where 90 per cent. of the catchment area has been closed to grazing under agreement in the last two years. The improvement in run-off regime is already considerable but even so the construction of a bund to guide the *cho* in the flat *bela* land has proved an expensive business, and its constant repair forms a financial burden which either Government or the community must face.

Grass Marketing.—On the outer slopes of the Katardhar we have been fortunate in having an almost inexhaustible market for cut grass in the adjoining plains, so that every headload of fodder grass can be readily sold at a profit, and contractors are ready to take up the cutting and removal of *bhabar* grass for the Jagadhri Paper Mills. The present shortage of fodder in the South-East Punjab has also kept up the prices and although little or no Siwalik grass has reached Hissar, very large quantities have gone out this season to Patiala State and other areas beyond Jullundur.

In order to secure large closures in the less accessible foothills such as the Sohan Dun and the Kangra Valley, it is essential that the outside marketing of grass be developed. The popularity of closures when grazing grounds are turned into hayfields, and grass cutting and stall-feeding are substituted for grazing, is soon exhausted if the villager has only his own needs to meet. We require to have some system of marketing built up so that there is a steady demand for fodder grass from year to year not subject to the occurrence of famine conditions in some other part of the province, but such that the foothills villager can be sure of a reasonable profit on his surplus hay. Just how this is to be arranged, I do not propose to outline in this paper; but I wish to bring to the notice of the Department and of Government that the co-operation of the agricultural

marketing expert is required if we are to find a sound solution to this problem. Unless it is solved we shall very soon exhaust the possibility of voluntary grazing closures in the less accessible foot-hill areas, because the villager is not going to forego his grazing unless he can make a profit on his cut hay.

Need for more trained staff.—With the extension of forest work into these new lines entailing closer co-operation with the villager, and fresh responsibilities for the Department in its new soil conservation programme, it is essential to get more of our staff of all ranks trained in this type of work. In fact the soil conservation programme is so essentially a departmental obligation that we cannot afford to have specialists in erosion control. Every forest officer, ranger and forester ought to have sufficient knowledge and experience of erosion control and village grassland management to be able to take over such duties. If substitute officers are not recruited and trained now, the experience gained by a few of the post-war officers will be lost when they leave the service.

Nomenclature of soil erosion control.—In spite of our natural prejudice against the use of Americanisms, I recommend to your notice the term "soil conservation" which they have adopted instead of "counter-erosion." It is a more constructive and more comprehensive term which effectively covers all the activities visualised by our new erosion circle. Particularly I wish to protest against the use of that awful hybrid "anti-erosion," which is half Greek and half Latin. To do the Americans justice they never perpetrated this enormity, which has unfortunately become current amongst Punjab forest officers.

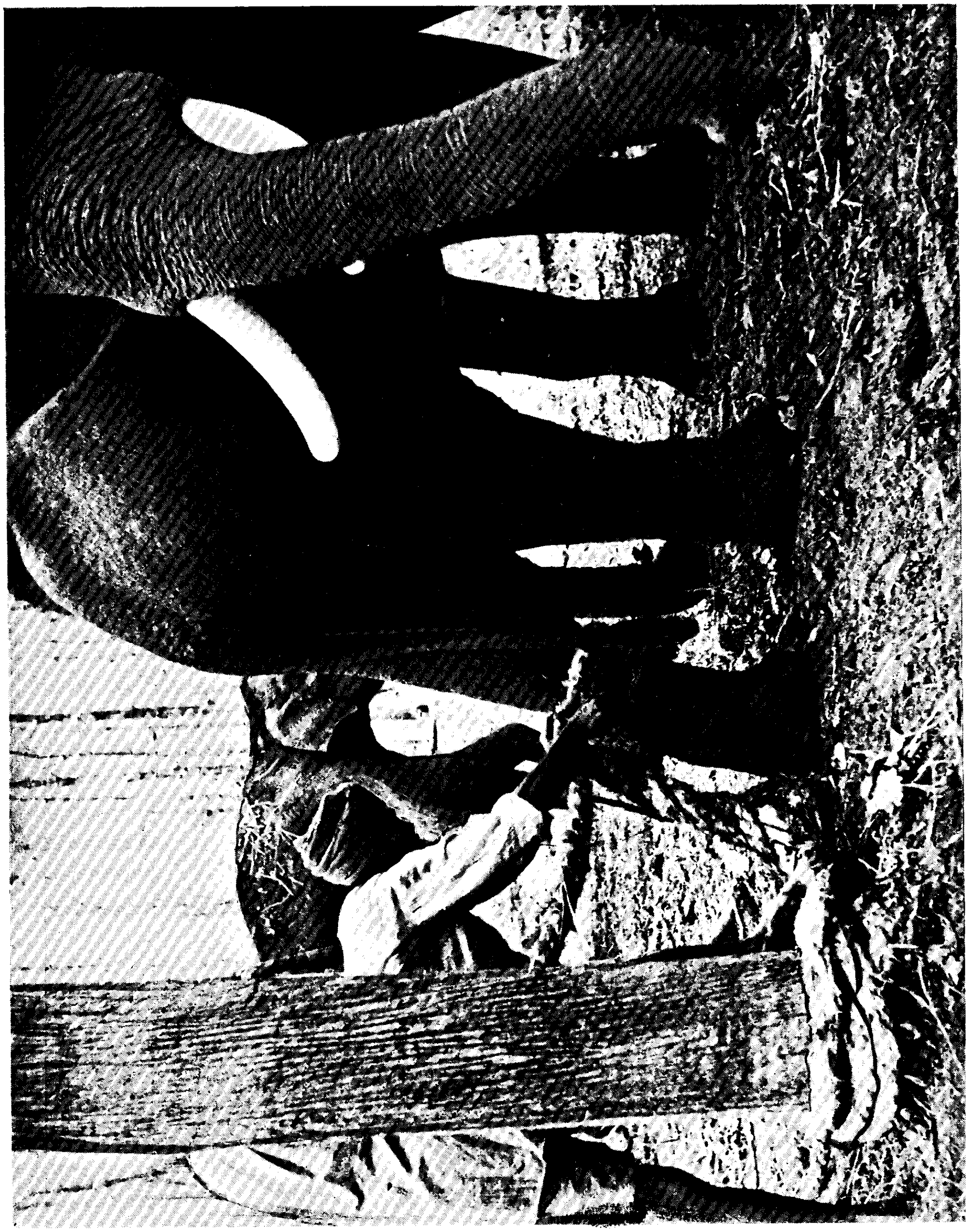
CAPTURE OF WILD ELEPHANTS

Recent Kheddah Operations in Mysore State.

By N. N.

In honour of the recent visit of His Excellency the Viceroy, the Mysore State had arranged for a Kheddah for the capture of wild elephants.

Securing a wild elephant to a tree. Two "kumkis" hold the animal fast while a "mahout" ties its legs



Tying a wild elephant's leg to a tree.

Months before His Excellency's visit was expected, an acre of forest, near Karapur, on the eastern border of the State, was marked off for the building of a stockade. The stockade was built out of huge logs of wood. A trench, more than ten feet wide, was dug all around it. This was to prevent the wild elephants from escaping, as it is well-known that they are incapable of jumping for more than a couple of feet.

Two sliding doors, built out of specially strong timber, opened into the stockade.

A month before the visit, trackers sighted a big herd of elephants at a place nearly 30 miles away from the stockade. More than 3,000 beaters, armed with noise-making bamboo rattles, surrounded it and drove it in the direction of the stockade. The driving operations were very successful and the whole herd, consisting of nearly sixty elephants, entered the wide open gates of the stockade.

On the day of His Excellency's visit to the Kheddah, the roping operations commenced. The roping was done in an "arena," separated from the rest of the stockade by walls of huge logs.

Two or three wild elephants were let into this arena. Eight "kumkis" (trained tame elephants each with a mahout on it) entered it from another gate. Two "kumkis"—very stout and big animals—chose a wild elephant and dexterously managed to hold it firm between their huge bellies. As soon as a firm hold was got, the mahouts on the "kumkis" quickly passed strong ropes round the wild animal's neck and secured it to the bellies of the "kumkis."

In this way, every one of the wild elephants was roped, led out from the stockade and secured to trees outside.

TIMBER PRICE LIST, MARCH-APRIL 1939
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing	*Tetrameles nudiflora*	Assam	Logs	Rs. 30-0-0 per ton in Calcutta.
Benteak	*Lagerstrœmia lanceolata*	Bombay	Squares	Rs. 32-0-0 to 64-0-0 per ton.
,,	,,	Madras	Logs	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal	*Pterocarpus marsupium*	Bombay	Logs	Rs. 48-0-0 to 84-0-0 per ton.
,,	,,	Madras	Logs	Rs. 0-15-7 to 1-3-3 per c.ft.
,,	,,	Bihar	Logs	Rs. 0-12-0 to 1-0-0 per c.ft.
,,	,,	Orissa	Logs	Rs. 0-7-0 to 1-2-0 per c.ft.
Blue pine	*Pinus excelsa*	N. W. F. P.	12′×10″×5″	Rs. 4-7-0 per piece.
,,	,,	Punjab	12′×10″×5″	Rs. 4-10-0 per piece.
Chir	*Pinus longifolia*	N. W. F. P.	9′×10″×5″	Rs. 1-12-0 per piece.
,,	,,	Punjab	9′×10″×5″	
,,	,,	U. P.	9′×10″×5″	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit	*Swintonia floribunda*	Bengal	Logs	
Deodar	*Cedrus deodara*	Jhelum	Logs	
,,	,,	Punjab	9′×10″×5″	Rs. 3-11-0 per piece.
Dhupa	*Vateria indica*	Madras	Logs	
Fir	*Abies & Picea* spp.	Punjab	9′×10″×5″	
Gamari	*Gmelina arborea*	Orissa	Logs	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan	*Dipterocarpus* spp.	Andamans	Squares	
,,	,,	Assam	Squares	Rs. 50-0-0 per ton.
,,	,,	Bengal	Logs	Rs. 30-0-0 to 35-0-0 per ton.
Haldu	*Adina cordifolia*	Assam	Squares	Rs. 1-2-0 per c.ft.
,,	,,	Bombay	Squares	Rs. 24-0-0 to 65-0-0 per ton.
,,	,,	C. P.	Squares	Rs. 0-4-0 to 0-13-0 per c.ft.
,,	,,	Madras	Logs	Rs. 1-3-0 per c.ft.
,,	,,	Bihar	Logs	Rs. 0-8-0 per c.ft.
,,	,,	Orissa	Logs	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea	*Hopea parviflora*	Madras	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood	*Dalbergia latifolia*	Bombay	Logs	Rs. 52-0-0 to 90-0-0 per ton.
,,	,,	C. P.	Logs	Rs. 1-0-0 to 1-2-0 per c.ft.
,,	,,	Orissa	Logs	Rs. 0-14-0 to 1-8-0 per c.ft.
,,	,,	Madras	Logs	Rs. 1-2-0 to 2-5-0 per c.ft.
Irul	*Xylia xylocarpa*	Madras	B. G. sleepers	Rs. 6-0-0 each.
Kindal	*Terminalia paniculata*	Madras	Logs	Rs. 0-8-6 to 1-4-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-4-0 to 0-10-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 2-6-9 to 6-1-3 per c.ft. in round.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-4-0 to 75-0-0 per ton.
" ..	" ..	" ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-9-3 each.
" ..	" ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
" ..	" ..	" ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
" ..	" ..	" ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
" ..	" ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-6-0 to 1-5-0 per c.ft.
" ..	" ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
" ..	" ..	" ..	B. G. sleepers	Rs. 4-14-3 to 5-4-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-8-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 33-0-0 per ton in Calcutta.
" ..	" ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per scantling.
" ..	" ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-12-10 to 1-6-0 per c.ft. in round.
" ..	" ..	U. P. ..	Logs ..	Rs. 0-14-0 to 1-6-6 per c.ft.
" ..	" ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
" ..	" ..	" ..	Logs 2nd class	
" ..	" ..	C. P. ..	Logs ..	Rs. 0-12-0 to 1-15-8 per c.ft.
" ..	" ..	" ..	Squares ..	Rs. 1-10-6 to 2-12-6 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-8-0 to 2-10-0 per c.ft.
" ..	" ..	Bombay ..	Logs ..	Rs. 67-0-0 to 100-0-0 per ton.
" ..	" ..	" ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	..

SIMPLICITY IN LIFE.—THE FAUNA OF BRITISH INDIA, PROTOZOA, SPOROZOA

BY B. L. BHATIA, D.SC., F.Z.S., F.R.M.S., F.N.I.

London, November 1938.

(*Pp. i—xx,* 1-497, 190 *figs.,* 2 *plates,* 1 *map. Price* 30 *shillings.*)

In the presidential address of one of the sections at the 1939 Indian Science Congress, the relative size of the subdivisions of the Animal Kingdom was illustrated by comparison with the span of a man's outstretched arm. On this scale of measurement the protozoa. or single-celled animals, occupy a small patch on one finger.

The protozoa that occur in India are being monographed in the *Fauna of British India* by Dr. B. L. Bhatia, who published his first volume three years ago (reviewed in the *Indian Forester,* 1937, p. 340), and now follows it with a second volume of 497 pages that deals with the class Sporozoa. There are 320 species of Sporozoa in India, Burma and Ceylon—a small fraction of the total known from other parts of the world—all of which are parasitic and cause diseases or physiological abnormalities in animals including man. A body consisting of a single cell with a parasitic existence should afford the greatest simplicity in life, nevertheless the variety is manifold. The diversity of hosts and parts of the body attacked by the sporozoan parasites is well presented in the author's list of parasites and their hosts, which occupies 20 pages of small print.

According to Dr. Bhatia the parasite of malignant tertian malaria should be termed *Laverania malariae* and those of benign tertian and

quartan malaria should be known as *Plasmodium vivax* and *Plasmodium malariae* respectively. Many malariologists, however, consider that the separation of the malignant tertian parasite from those of benign tertian and quartan malaria is not required on zoological grounds and include all three in the genus *Plasmodium*. A useful summary is given of the differential characters of human malarial parasites and of the distribution of the diseases and their mosquito-carriers.

The sporozoan parasites of insects are numerous and among the hosts biting insects predominate—a fact that may be attributed to the industry of medical investigators and the relative inactivity of agricultural entomologists rather than to any special susceptibility of mosquitoes and fleas. We suspect that insect diseases of the type of *Nosema* are more common than is supposed and that one day they will acquire importance as a means of controlling pests.

There are 190 text figures which illustrate the great variety of form that a simple single-celled organism may display, and there are two coloured plates of malarial parasites. The bibliography runs to 99 pages.

C. F. C. B.

CONSERVATION OF THE SOIL

BY PROFESSOR A. F. GUSTAGSON

[*McGrand Hill Publications. Pp. xvii* + 312 : 18*s*.]

Describes the main principles of soil conservation. It emphasises that the art of soil conservation is kindly treatment and that moderation in the use of all the scientific equipment already evolved is of more importance than further scientific development. An example of the ways in which scientific apparatus can be most usefully employed is the application of charts of rainfall—intensity frequency to the design of works for protection against floods. Nature, with her physic of trees and grasses, is a better doctor than the engineer who can only apply the technique of a surgeon in order to keep alive a patient in an advanced state of ill-health. During the last century great advances were made in soil exploitation to meet the

demands of expanding populations. Owing, however, to the neglect of the ancient art of soil conservation, the fertility of soils all over the world has suffered a grievous decline and soil erosion has become a common disease. Latterly, a realisation of the wisdom of ancient practices has grown and forests and grasslands, formerly regarded as insufficient methods of utilising land, have now begun to be appreciated at their true worth as efficient conservators of the soil and preventatives of floods.

EXTRACTS

WOOD AND CHARCOAL AS MOTOR FUEL

COTTAGE INDUSTRY

Dr. V. S. Dubey of Benares University writes:

Recently during the last ten years, great progress has been made in the use of wood and charcoal as motor fuel in Europe. For this purpose the wood or charcoal is turned into producer gas which is passed into motor cylinders instead of petrol vapour. These gas producers are fitted by the side of the driver's seat or at the rear end of the vehicle. In Germany at present there are several thousand automobiles using wood gas; and this type of fuel is well established. But in India, though it is ideally suited for this kind of automobiles nothing has been done till now. We are importing petroleum at a very high cost while cheap wood and charcoal occur in abundance in the country.

In France from 1935, the Government has decided to hold two National Exhibitions annually, embracing (1) Utilisation of wood and charcoal gas motors for agriculture; (2) Utilisation of wood and charcoal gas for motors for transport; (3) Stationary and mobile plants for wood gas motors and (4) Wood and charcoal gas producers.

A National Committee has been formed in that country to report on all departmental questions dealing with wood gas. The result of this has been that there the number of lorries and trucks worked by gas has greatly increased. In France wood charcoal is greatly used in these vehicles, but in Germany there are beautiful passenger lorries running on the gas generated from wood itself.

Experiments have proved conclusively that one gallon of petrol is equivalent to 10-12 lbs. of charcoal or 20-24 lbs. of wood. The cost of a gallon of petrol in India ranges from rupee one to Rs. 1-12,

while five seers of charcoal, which is equivalent to one gallon of petrol, costs one to two annas. Thus, we clearly see that we can replace petroleum by the home grown fuel which would only be about eight per cent. of the present cost.

The adoption of these wood gas and charcoal lorries will make the cost of transport very low, which will help the development of many new industries. For example, in the Himalayas, where no other means of transport than by lorries is possible, many mineral deposits at present unworkable due to the high cost of transport, would then become workable.

The production of wood charcoal as a cottage industry will greatly help the villagers in the forest areas. Wood gas is an ideal source of power in villages where stalks of cotton and other agricultural waste can be turned to produce gas and utilise it for power.

Looking to all these factors the Government should try to encourage the use of charcoal and wood gas in automobiles and trucks.

For this purpose the following steps should be taken:

(1) The Government should buy a few wood and charcoal gas vehicles as models and send them to all districts for propaganda so that the people can become acquainted of their uses.

(2) The Government should hold exhibitions where all important firms of Europe manufacturing these gas vehicles may also be encouraged to take part.

(3) The Government should compile literature dealing with these gas engines and distribute freely among persons interested.

(4) The Government should take up the investigations on different kinds of charcoal and wood available in India. (Such investigations have been carried out in Canada where the efficiency of different species of charcoal and wood has been fully tested.)

With all this encouragement, it is hoped that within a few years we will have several thousand lorries running on this home grown fuel, saving lakhs of rupees from going out of the country as well as providing employment to a large number of people, especially villagers.—(*The Tribune, 14th February* 1939.)

A NEW MICROSCOPE

Prolonged tests have now proved that the super-microscope, recently demonstrated to the public of New York, is an instrument of immense practical value. There is every possibility that it may go down to history as the outstanding invention of the twentieth century. Tiny disease germs that are quite beyond the range of the ordinary optical microscope have been photographed with clarity and detail. The super-microscope has opened up an entirely new field in the science of bacteriology, and that is only one aspect of its usefulness.

The basic limit of the optical microscope was reached years ago, although minor inventions and ideas have improved it in certain specialist directions. The limit of the ordinary microscope is governed by the wave-length of light, which is far too coarse for the purpose of investigating the world of the infinitely little. Light waves are about one fifty-thousandth of an inch long. This seems small enough but there are many things much smaller. The germ that causes measles is a typical example; it cannot be identified by an optical microscope.

The new microscope uses electrons instead of light, and if there is anything smaller than an electron, science has yet to discover it. The idea of using electrons for detecting very minute bodies was talked about ten years ago but the method eluded the research workers until 1932 when Professor Ernst Ruska of Germany announced that he had invented a machine—on paper. He began to build models to prove that his theories were correct. To-day, his first working super-microscope is producing extraordinary results, and no doubt these will be regarded as crude and coarse when the new instrument has been perfected.

The apparatus looks more like a machine than an optical instrument. It stands higher than a tall man and gives the impression of a howitzer with knobs on. Inside the central metal tube a vacuum is maintained so that the electrons meet with no resistance as they go about their work. Air molecules would be too coarse a medium for the electrons to operate in. Attached to the tube is an instrument panel studded with dials and controls to enable the operator to keep in strict harness the 80,000 volts of electricity required to set up a stream of electrons.

The basic idea of the super-microscope is simple enough. A narrow beam of electrons is made to pass through the object being studied. The beam is then "coned" out to give an amplified image. In ordinary microscopes amplification is obtained by lenses which bend the light out of its natural path. Glass lenses are useless for electrons because glass is not transparent to them in the sense that it is to light. The super-microscope uses magnets and induction coils to establish electric fields of force at strategic points. These pull the narrow beam into a cone-shaped mass of flying electrons and at the base of the cone there is a screen on which the electrons impinge.

The beam of electrons shoots downwards, at nearly 100,000 miles a second, through a small aperture near the top of the machine. Magnetic fields "waist" the beam to an incredibly small diameter at the point where the object under examination is placed. Let us suppose that a group of bacteria is being studied. Some of the electrons are stopped by the denser portions of the bacteria. Others pass unchecked through the more transparent parts. Once the beam, or what is left of it, has passed through the object, it is fanned out in all directions at once and equally. Eventually, the ever-widening beam strikes a screen which is coated with a chemical capable of converting the impact of each electron into a point of light.

The observer looks through an eyepiece in the base of the machine and sees a televised half-tone, incredibly magnified, of the objects under study.

The super-microscope has already photographed bacteria 20,000 times larger than life, whereas the optical microscope's limit of magnification is 2,000 times larger than life. As a beginning this is no mean effort. Given sufficient capital it would be possible to build a super-microscope as tall as a skyscraper and with it to magnify germs to the size of elephants. Theoretically, there is no limit to the degree of magnification possible.

All kinds of people will want to use the super-microscope. With its help textile experts will be able to devise new fabrics and to improve existing ones. Metallurgists may discover in it the Philosopher's Stone of the ancient alchemists, the magic instrument

that will enable them to convert one metal into another by the simple process of re-arranging the atoms. Scientific detectives will unearth new sorts of clues with its aid. Even brewers may use it to study more closely the mystery of fermentation. Biologists need it badly for the study of genes, the infinitesimally tiny things that determine whether a person shall have brown hair, blue eyes, and so on. Genes are so small that a five-grain aspirin tablet would be large enough to contain all the genes necessary to determine the heredity of the next two million babies. Chemists need the super-microscope for the closer study of complex molecules, both for industrial and health purposes. The mystery of cancer may at last be probed by the new eyes. There are endless possibilities.

The electron microscope has its limitations. The optical instrument can study things alive and can often watch harmful bacteria at their fell work. The electron beam is a death-ray that kills anything left alive by the vacuum in which it works. This is not a serious handicap; the facts of an organism's life may perhaps be reconstructed by obtaining many photographs of it in death. In any case, the super-microscope taps a world that is largely below the scale of life as we understand it, that indeterminate field between the organic and the inorganic.

However, the electron microscope will never be able to reveal the secret of life itself.

A New Era

Intense interest has been aroused among scientists by the news that Dr. Vladimir Zworykin's new "ultra microscope," said to be capable of magnifying up to 1,000,000 times, has been demonstrated at Richmond, Virginia.

There is certain to be considerable controversy about the nature of Dr. Zworykin's apparatus. Some students of microscopy hold that it is not a microscope at all. That question, and others concerned with Dr. Zworykin's claims, will be raised shortly at a special meeting of scientists in London.

"It is contemplated," Dr. Clarence Tierney, Secretary of the Royal Microscope Society, told an *Observer* representative recently, "that Dr. Zworykin's new apparatus shall be thoroughly discussed at a meeting of the society. It is difficult to make any definite statement until the matter has been thrashed out at that discussion,"

Bacteria Seen.—Dr. Zworykin's instrument uses electrons instead of light. The objects magnified are projected on a fluorescent screen. At the demonstration bacteria never revealed before were shown to a large audience of scientists and technicians.

Those who say that the apparatus is not a microscope point out that according to reports the images shown by it are not "resolute." They are more like the outlines thrown by a shadowgraph, or the objects revealed by X-ray photography.

To this others object that the apparatus is performing a function beyond the scope of any microscope. They argue that even if the ordinary microscope uses ultra-violet instead of ordinary light rays, it is limited to certain wave lengths. Nothing smaller than these light waves can be shown.

In other words, the microscope, as we understand it, has reached the limit of its usefulness, or the limit of smallness in the forms of life which it can reveal.

Revolutionary Apparatus.—Although it may not have the precision of the ordinary microscope, Dr. Zworykin's apparatus probably reveals, at any rate in outline, forms of life and energy which have not hitherto been visible at all.

One of its uses, if it can show ordinary molecules with sufficient accuracy, may be to do away with the need for elaborate X-ray study of large and complicated molecules.

Dr. Zworykin, Director of the Electronic Research Laboratory at Richmond, was closely associated with the invention of the television camera.

Indeed, his new "ultra microscope" is allied technically to the ordinary television camera. The electrons emitted by the object to be studied are focused by a powerful magnetic field, and the focused image, much magnified, is shown, as in the television receiver on a fluorescent screen.—(*Hindustan Times, 30th January* 1939.)

SOIL DENUDATION AS ADVERSE FACTOR ON RIVER SUPPLIES AND AGRICULTURE

[*Central Board of Irrigation Quarterly Bulletin No.* 12, *October to December* 1938.]

The following extracts may be of interest to those connected with forestry in India: "Soil Denudation as Adverse Factor on River Supplies and Agriculture" was the new title adopted by the Board for the problem dealing with the effects of deforestation on irrigation projects. Dr. Burns, Technical Adviser to the Imperial Council of Agricultural Research, and Dr. Gorrie, I.F.S., Punjab, were present during the discussion on this problem. The Board agreed that the major evils resulting from soil denudation were: (*a*) the increase of intensity of floods, (*b*) the decrease of the dry weather flow in rivers, (*c*) increased silt charges in the rivers, (*d*) deterioration of the rivers, and (*e*) reduction in the cultivated areas.

Dr. Burns informed the Board that the problem was receiving very careful consideration by the Imperial Council of Agricultural Research, and Sir John Russell, in his report on agricultural research in India, had drawn attention to this problem with which India was faced, and had stated that there was ample evidence that denudation was taking place on a large scale, and that immediate action was necessary.

The Board agreed that the situation was acute and that immediate action for preventing further damage should be taken without further investigations.

Dr. Gorrie explained the methods adopted in the Hoshiarpur District in the Punjab and compared them with methods used in the Etawah District in the United Provinces. He said that it was impossible to evolve a system which would suit all conditions and each case had to be considered on its merits.

The Board came to the conclusion that the best method of tackling the problem was for the Provinces and States to take up a large number of small schemes similar to those undertaken in the Punjab and the United Provinces—the nature of the scheme depending upon the local conditions,

The President said that there was much more chance of success if systems were introduced by which the local villagers could see some advantage to themselves in the measures introduced to prevent denudation. Dr. Gorrie informed the Board that the system adopted in Hoshiarpur of checking grazing and substituting grass cutting was self-supporting, as there was a market for both fodder grasses and *chabbar* grass for paper.

The Board passed the following resolution on the subject:

This Board is convinced that the evils of denudation in India are so serious and widespread that action for its further prevention should be taken without further delay. Denudation causes high floods in summer and low river levels and small supplies in winter, which result in—

(*a*) damage to canal systems through interference with the regularity of canal supplies,

(*b*) harmful deposits of sand,

(*c*) interference with river navigation, and

(*d*) widespread damage to the country-side.

Methods which have been found effective depend on the local conditions. They include—

(*i*) better field cultivation in order to reduce erosion from plough land,

(*ii*) better live-stock management in order to reduce erosion from grazing lands,

(*iii*) afforestation of such village waste land as can be devoted to the production of timber, fuel and fodder trees,

(*iv*) the conservation of grass land,

(*v*) the substitution of organised taungya for shifting cultivation.

The Board considers that all Provincial and State Governments should be urged to develop and extend the most suitable local machinery to deal with further denudation and the above-mentioned allied problems.

CENTRAL BOARD OF IRRIGATION, QUARTERLY BULLETIN NO. 12, OCTOBER TO DECEMBER 1938

Printed catalogues of the books, etc., in the Board's library are not available as the cost and time involved in preparing them are not commensurate with the advantages gained. The quarterly bulletin contains a list, with abstracts, of all the literature received in the library during the quarter, and with the author and subject card indexing system in use, it is possible to supply at once any information concerning the literature in the library which could be obtained from a printed catalogue. Readers of this Bulletin who desire to borrow literature from the Board's library are invited to address the Secretary, stating the names of authors of any literature they have in mind, or the subjects in which they are interested.

Under the abstracts of literature received during the quarter, the following are included:

Recommendations regarding the methods of determining general rainfall over any area are made in a report issued by a committee of representatives from the British Rainfall Organisation, the Royal Meteorological Society and the Institution of Water Engineers (*Water and Water Engineering, Vol. XXXIX, No.* 487).

A number of articles describing the construction of earth roads with a treated surface in Southern United States are published in the *Engineering News-Record* (Vol. 121, Nos. 10, 13, 14, 16).

An extended summary of an article by Horton entitled "Hydrologic Aspects of the Problem of Stabilising Stream Flow," which appeared in the *Journal of Forestry, Vol.* 35, *No.* 11, *November* 1937, is also given.

> "Methods and means of regulation of stream flow are discussed in this article. There are three schools of thought who advocate three different lines of approach to the problem of stream-flow regulation. One school comprising many

engineers hold that stabilisation can best be accomplished by surface storage reservoirs. There are numerous examples of successful stream regulation by reservoirs but the method has its economic limitations which are enumerated and discussed. The second school of thought consists of foresters and conservation enthusiasts who claim that forests are natural stream flow regulators and that if forests are maintained in a drainage basin, particularly in the mountainous headwater regions, much can be accomplished in the way of stream flow regulation including elimination of floods and maintenance of regular low water flow. It was considered that the sponge-like action of forest litter was mainly responsible for the conservation of water and stream regulation. Recent knowledge acquired on the subject, however, shows that the leaf litter theory of stream stabilisation by forests is unsound, and the beneficial effects of forests on stream regulation are questionable. Certain facts in support of this view are discussed. There are, however, certain conditions associated with forest soils which may have a beneficial effect on stream regulation, which are stated. The most important amongst these is the greater infiltration capacity of forest soils. Recently a third school of thought regarding stream flow regulation has come into prominence as a result of advances in scientific hydrology. The tenet of this school is that something may be accomplished in stabilising stream flow if some practical means could be found to increase the infiltration of the soil. The author then discusses several possible methods of increasing total infiltration, and its effect with reference to increase of total available soil moisture and changes in total run-off and stream flow regulations. Infiltration may be increased by keeping the soil in good tilth, and cultivating promptly when the soil has become sunbaked or rain packed; by increasing the length of overland flow by terracing and other means; by encouraging grass and close growing grain crops; and by increasing depression storage by strip cropping. The author presents an

analysis of the rainfall in a particular area in order to determine the changes of soil moisture and ground water accretion quantitatively. The results obtained are discussed and the quantitative effect of increased infiltration on soil moisture and run-off is shown."

The following information is taken from the accounts relating to the

IMPORTS

ARTICLES	QUANTITY					
	MONTH OF FEBRUARY			11 MONTHS 1ST APRIL TO END OF FEBRUARY		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
Siam ..	50	226	31	944	1,105	806
French Indo-China	292	151	77	2,700	1,996	3,510
Burma ..	..	10,591	12,231	..	1,44,047	1,39,517
Java ..	..	295	..	1,680	4,678	2,863
Other countries ..	..	..	45	1	637	81
Total ..	342	11,263	12,384	5,325	1,52,463	1,46,777
Other than Teak—						
Softwoods ..	389	1,141	733	12,965	18,185	14,547
Matchwoods ..	806	413	351	10,635	9,082	7,901
Unspecified (value)	..	..	..	..	..	..
Firewood ..	..	70	31	325	597	631
Sandalwood ..	19	23	..	252	142	146
Total (value) ..	..	..	..	..	..	..
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	..	76	..	662	399
Plywood ..	538	248	423	3,107	4,748	5,584
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total (value) ..	..	..	..	..	..	..
Total value of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	3,434	14,393	12,615	2,01,933	1,83,522	2,60,262

Seaborne Trade and Navigation of British India for February 1939 :

IMPORTS

ARTICLES	VALUE					
	MONTH OF FEBRUARY			11 MONTHS, 1ST APRIL TO END OF FEBRUARY		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
Siam ..	4,627	27,811	5,924	1,15,712	1,41,261	1,06,489
French Indo-China	35,124	21,935	8,638	2,78,273	2,36,921	4,21,954
Burma ..	..	13,85,650	15,28,623	..	1,85,39,326	1,83,37,140
Java ..	..	35,270	..	1,82,268	5,97,659	2,94,683
Other countries ..	..	..	4,292	93	71,218	9,402
Total ..	39,751	14,70, 666	15,47,477	5,76,346	1,95,86,385	1,91,69,668
Other than Teak—						
Softwoods ..	20,013	87,557	47,016	7,74,805	13,76,513	10,26,109
Matchwoods ..	41,280	20,668	22,791	5,95,720	5,54,897	5,14,999
Unspecified (value)	21,131	2,74,549	2,43,438	3,21,856	26,52,631	28,75,659
Firewood ..	..	1,053	465	4,863	8,961	7,904
Sandalwood ..	6,789	3,443	71	84,944	38,678	37,509
Total (value) ..	89,213	3,87,270	3,13,781	17,82,188	46,31,680	44,62,180
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	..	7,662	..	81,593	55,413
Plywood ..	83,193	62,069	92,267	6,88,866	10,38,146	11,62,397
Other manufactures of wood (value) ..	95,661	1,25,076	1,21,026	13,56,706	16,99,078	14,82,047
Total (value) ..	1,78,854	1,87,145	2,20,955	20,45,572	28,18,817	26,99,857
Total value of Wood and Timber ..	3,07,818	20,45,081	20,82,213	44,04,106	2,70,36,882	2,63,31,705
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	28,839	1,23,261	1,32,062	13,22,307	13,74,267	23,96,697

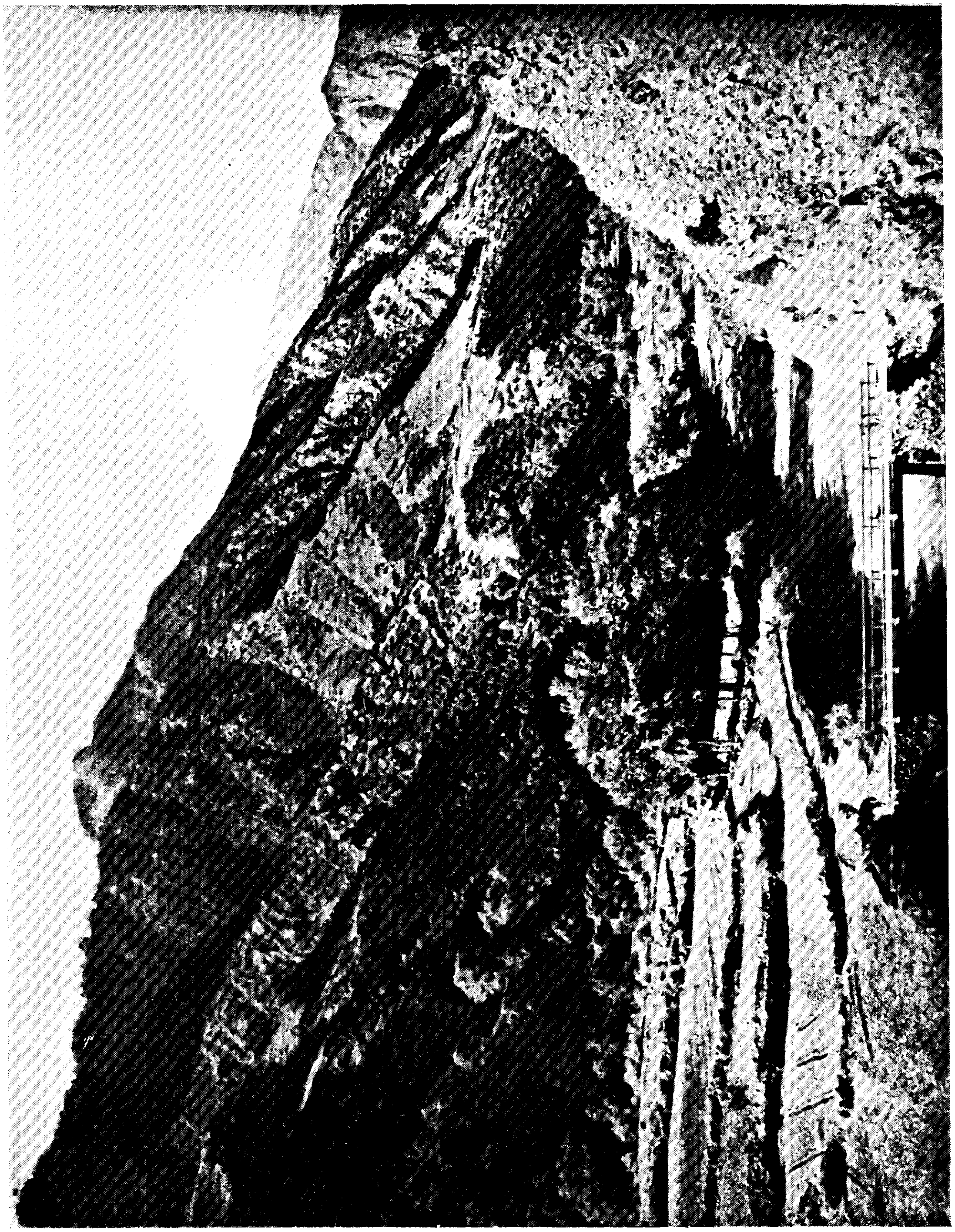
EXPORTS

ARTICLES	QUANTITY					
	Month of February			11 Months, 1st April to end of February.		
	1937	1938	1939	1936-37	1937-38	1938-39
Wood and Timber						
Teakwood—						
To United Kingdom	3,891	22	..	40,761	229	47
,, Germany ..	182	..	..	4,533	..	1
,, Iraq ..	246	66	20	705	238	220
,, Ceylon ..	257	..	..	1,428	4	2
,, Union of South Africa ..	627	..	..	6,101	..	..
,, Portuguese East Africa ..	196	..	..	1,967	..	..
,, United States of America ..	4	..	..	432	..	..
,, Other countries	546	189	175	5,885	927	1,896
Total ..	5,949	277	195	61,812	1,398	2,166
Teak keys (tons) ..	267	..	..	3,544	..	..
Hardwoods other than teak ..	216	..	..	1,497	15	2
Unspecified (value)	..	..	..	..	..	..
Firewood ..	1	..	..	7	167	..
Total (value) ..	..	..	..	..	..	..
Sandalwood—						
To United Kingdom	1	5	10	8	22	23
,, Japan ..	7	..	..	80	65	45
,, United States of America ..	115	50	25	455	588	344
,, Other countries	7	20	26	188	312	186
Total ..	130	75	61	731	987	598
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	..	..	..	..	..	..
Total value of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber	No data			No data		

Other Kinds
of wood + timber

EXPORTS

ARTICLES	VALUE					
	Month of February			11 Months, 1st April to end of February		
	1937	1938	1939	1936-37	1937-38	1938-39
Wood and Timber						
Teakwood—						
To United Kingdom	8,34,392	2,781	..	84,74,523	30,947	5,969
,, Germany ..	48,458	..	..	10,82,674	..	150
,, Iraq ..	36,544	12,117	5,928	1,23,706	42,469	62,869
,, Ceylon ..	39,454	..	..	2,02,316	266	343
,, Union of South Africa ..	1,40,740	..	..	12,50,264	..	..
,, Portuguese East Africa ..	35,567	..	..	3,38,150	..	..
,, United States of America ..	1,092	..	..	1,26,012	..	..
,, Other countries	1,19,375	25,497	56,428	12,65,968	2,31,956	6,81,457
Total ..	12,55,622	40,395	62,356	1,28,63,613	3,05,638	7,50,788
Teak keys ..	38,510	..	..	4,99,877	..	..
Hardwoods other than teak ..	20,145	..	..	1,52,931	4,020	422
Unspecified (value)	1,80,602	44,380	52,354	8,30,697	11,22,690	3,04,041
Firewood ..	31	..	..	111	1,735	..
Total (value) ..	2,39,288	44,380	52,354	14,83,616	11,28,445	3,04,463
Sandalwood—						
To United Kingdom	1,500	6,000	12,000	8,300	2,40,030	26,580
,, Japan ..	7,400	..	..	1,38,758	64,680	47,533
,, United States of America ..	1,18,000	50,000	30,000	4,94,548	5,95,715	3,54,380
,, Other countries	5,132	19,186	23,235	2,26,511	3,12,100	1,75,723
Total ..	1,32,032	75,186	65,235	8,68,117	9,96,525	6,04,216
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	24,788	31,809	38,225	1,38,776	2,84,047	4,88,901
Total value of Wood and Timbers ..	16,51,730	1,91,770	2,18,170	1,53,54,122	27,14,655	21,48,368
Other Products of Wood and Timber	No data			No data		



The Shishi Valley with *Quercus Ilex* on the lower slopes.

Photo: H. L. Wright.
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INDIAN FORESTER

JUNE 1939

FORESTRY BEYOND THE INDUS

BY H. L. WRIGHT, I.F.S.

II.—THE CHITRAL FORESTS

(*Continued from page* 254 *of the "Indian Forester" for May,* 1939.)

To the forester the chief interest of Chitral lies not so much in its marking the northern limit of the deodar, as in its being the most northern tract with which the Forest Department in India is connected. For here the massive range of the Hindu Kush forms an effective frontier to Afghanistan, of which a narrow strip in the valley of the Oxus is all that separates the Indian Empire from Russian Turkestan.

Chitral is about the size of Wales. It is entirely mountainous and possesses in Tirich Mir (25,426 feet) one of the highest peaks in the world. The whole country is drained by the Kunhar river which, after leaving the State, enters Afghanistan, where it joins the Kabul river near Jellahabad, and as such flows into British India not far from Peshawar. The Kunhar river is the only practical line of export for Chitral timber, and it is the two hundred miles of floating through Afghan territory that has been and always will be the deciding factor in forest management in Chitral.

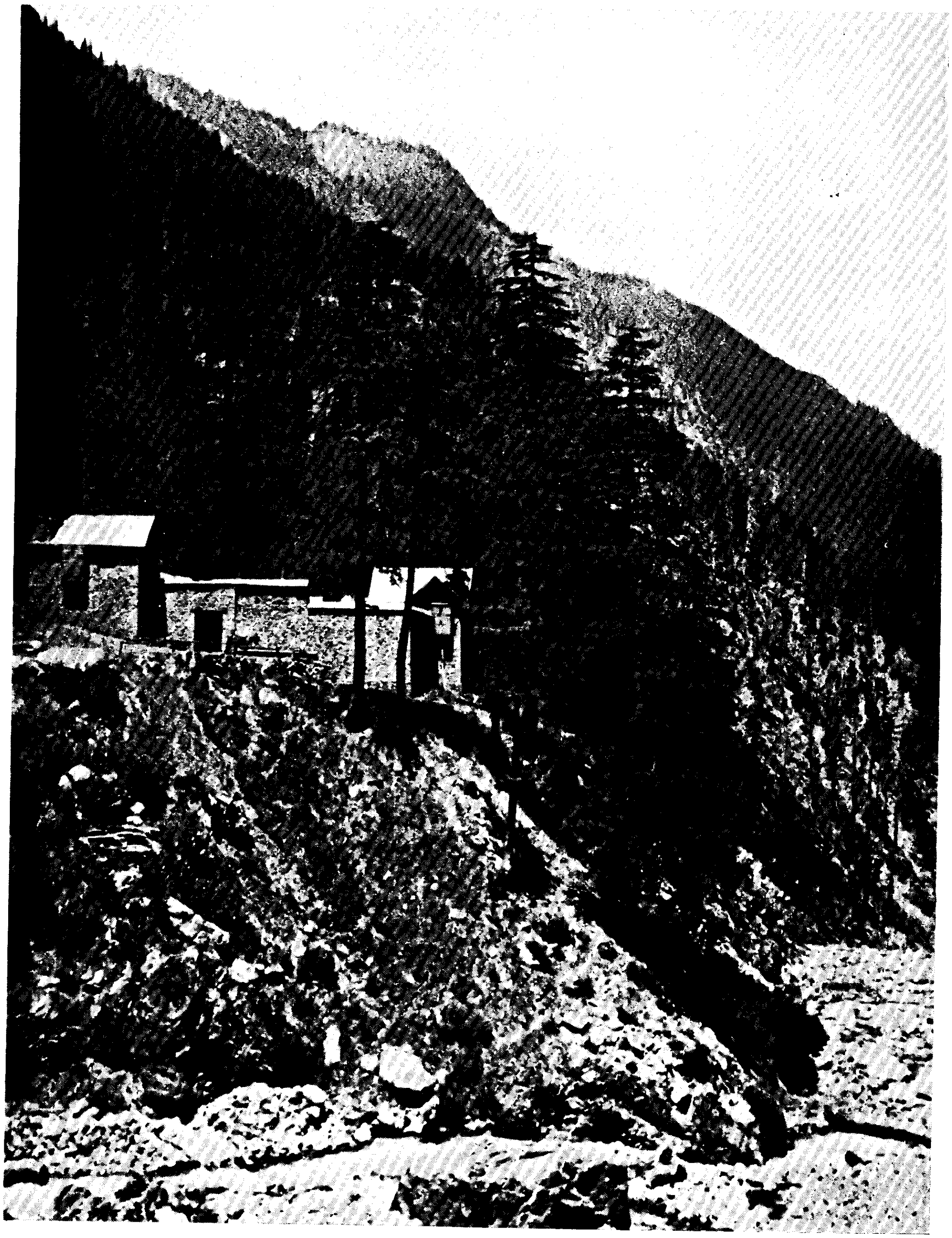
Chitral is no longer the inaccessible country it was in days gone by, for leaving aside travel by aircraft, which get there in an hour from Risalpur, it is quite possible, in the long days of summer, to leave Peshawar in the early morning and to be in Drosh, the garrison town, or Chitral, the capital, the same evening. But this is hard going, and the usual way is to motor as far as Dir, the capital of Dir State, on the first day and after staying the night at the levy post to cross the Lowari Pass to Ziarat, the first levy post on the Chitral side, on the next, and to reach Drosh or Chitral on the third day.

From Dir to Drosh is thirty-six miles, and the last ten miles of this can be done by car, for His Highness the Mehtar, with considerable enterprise, had a fleet of Fords brought across the pass in parts and reassembled the other side, so that from Mirkhani, where the road from the pass joins the main valley, it is possible to motor right up to Chitral. But for those with weak nerves it is better to walk or to ride, for the Chitrali driver, with a contempt bred by familiarity, is quite unmoved when the off back wheel skims perilously near the edge of the road, which in most places drops sheer down to the river.

The forests are found in all the side valleys on both sides of the Kunhar river from the Afghan frontier as far as Chitral itself, above which the deodar disappears. They form an almost continuous belt, between 6,200 and 10,500 feet for a distance of roughly seventy-five miles, and are typically dry zone deodar forests, for the rainfall of Chitral is only thirteen inches, of which five fall during the winter. The forests contain small numbers of blue pine and silver fir, and in places there are a few *chilgoza* (*Pinus gerardiana*), but deodar forms roughly ninety per cent. of the growing stock, and is generally almost pure.

One of the interests of the Chitral forests is that they enable us to see what deodar forests in India must have been like before they were brought under management some 60 to 70 years ago. They are full of dead trees, the result of past fires, while everywhere mature and over-mature trees predominate. Regeneration is on the whole excellent, except on hot steep slopes, where the soil is rapidly being washed away and deodar is losing ground. The forests have neither been demarcated nor settled and protection is purely nominal. But except for periodic and fairly localised burning, damage is not important; grazing is not heavy and the demands of the local people for timber are small. As with all dry zone deodar, the trees are slow growing and of rather poor quality, one noticeable feature being the thickness of the bark. The timber, too, is markedly inferior, being very liable to cracks and shakes, and it is doubtful whether sleepers cut from these trees would find favour with the Indian Railways.

The first and only real examination of these forests was made as long ago as 1908 by Khan Bahadur Munshi Imamuddin, an



The levy post at Ziarat, picturesquely situated in deodar forest.

Photo: H. L. Wright.
(Copyright.)

The Kuldam Gol forest—pure deodar with excellent regeneration. In the background can be seen the Kunhar Valley leading up to Chitral.

Photo: H. L. Wright.
(Copyright.)

officer of the Punjab Forest Service, who spent three months in the State and submitted an excellent report, which even now provides the only detailed information we have regarding the forest resources of the State. According to this report the total area of the forests is 38,000 acres or 60 square miles, but this figure was calculated from the old survey sheets and may be wide of the mark. The Khan Bahadur also made a rough assessment of the standing crop of I Class trees (24 inches in diameter and over), and although this was based on very imperfect data, *viz.*, the enumeration of five small sample plots, it gave him the material from which to calculate a provisional yield. According to his estimate the forests contained 187,800 deodar and 9,200 blue pine trees 24 inches in diameter and over, and from ring countings he determined that the average age of an 18-inch tree was 125 years and of a 24-inch tree 175 years. The recruitment period from the 2nd to the 1st Class was thus 50 years and during this period he proposed to remove three-quarters of the 1st Class deodar and all the 1st Class blue pine, giving an annual yield of 2,817 deodar and 184 blue pine.

But use was never made of this calculation, for as then pointed out, the great difficulty in working these forests is their geographical situation, for unless the Afghan Government give permission for the passage of Chitral timber, and not only that, guarantee its safety in transit, there could be no hope of these forests becoming of commercial importance.

So, for twenty-one years after the Khan Bahadur's visit, very little happened. Various contractors, chancing their luck, extracted logs and brought them down to the river bank in the hope of getting permission from the Afghan Government to float their timber, but this was not given, and rotting logs remain as evidence of these past failures. In 1929, however, when prospects of a settlement appeared more rosy than usual, Holland, one of the Punjab Conservators was, at the request of His Highness the Mehtar, deputed to Chitral for a month to mark trees for a prospective purchaser. Chitral was a long journey from the Punjab before the motor road to Dir, and out of this month, he was able to spend only a week in the State, during which he marked two thousand 1st Class trees in the Shishi Valley. But after his visit negotiations with Afghan-

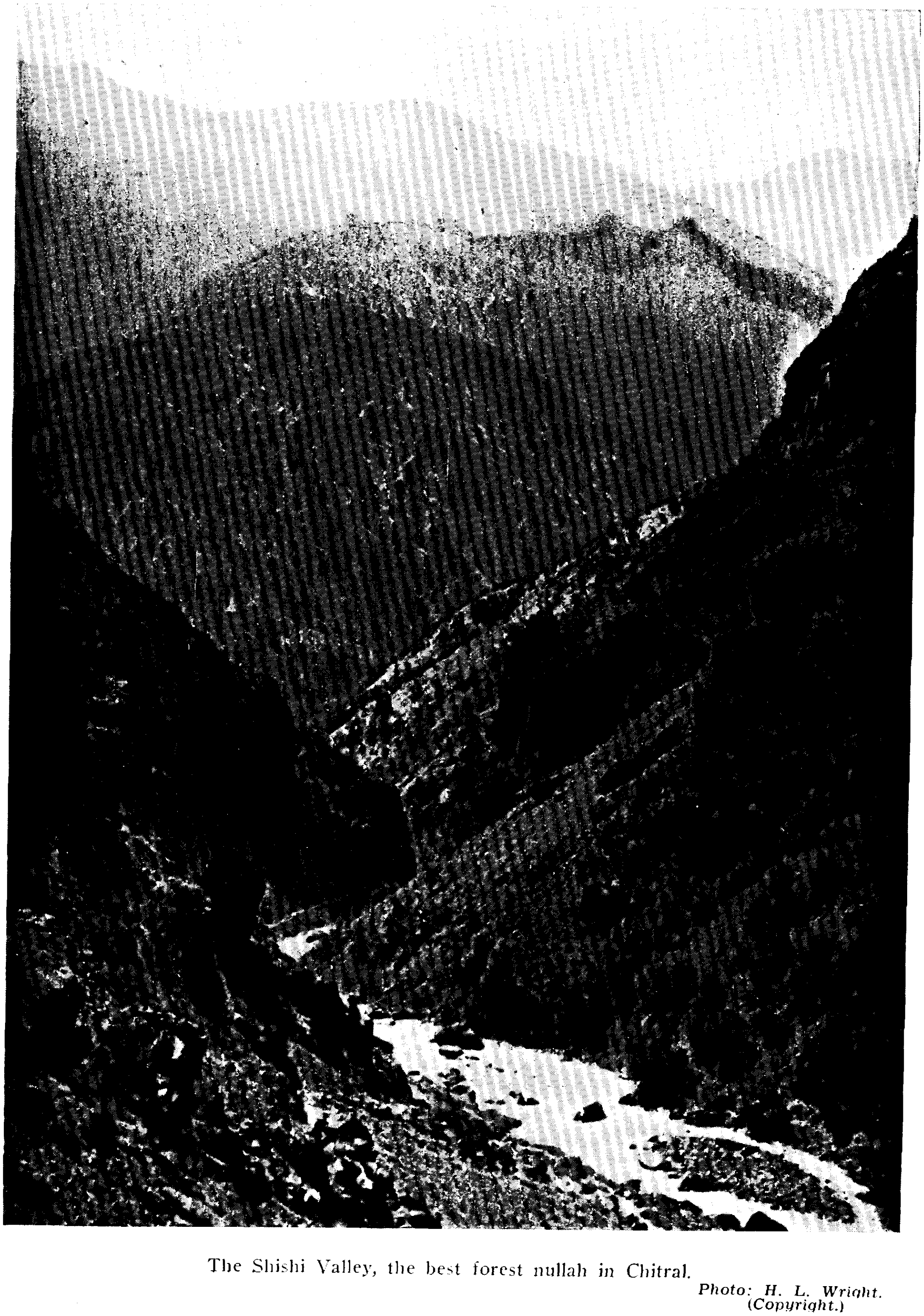
istan again broke down; no sale materialised and the trees remained standing.

Nothing further happened until 1934, when an entrepreneur from the Punjab obtained a concession from His Highness for five thousand trees. He professed to be *persona grata* with the Afghan Government, and to be able to obtain permission to float his timber to Peshawar. Government, therefore, agreed to the trees being given to him, and these were marked by Khan Bahadur Khan Mohamed Khan of the Peshawar Division, and included Holland's previous marking. The contractor, however, felled only six hundred trees, from which fifteen hundred logs were extracted and brought to the Shishi river, but here the work stopped for the contractor was unable to come to terms with the Afghan Government.

Turning now to more recent history. Early in 1936, another contractor came forward whose expressed intention was not to export logs through Afghanistan, but to convert sleepers and to carry them over the Lowari Pass to Dir, and thence by motor lorry to the rail-head at Dargai. He was, therefore, given the trees left by the previous contractor and, during 1936, extracted some fifteen thousand scantlings of which twelve thousand were broad-gauge sleepers. These were floated down to near the junction of the Lowari road and landed there, but so far none of them has been taken across to Dir by camels. Nor is it likely that any of them ever will be, for the whole scheme was fantastic, with deodar sleepers selling at less than it would cost to carry them to rail-head.

Since then, sleeper work has been shut down and the contractor has been devoting his attention to logs, for during 1937 a Chitral delegation, headed by His Highness's brother, went to Kabul to discuss the terms on which floating should be allowed. The agreement then concluded is now awaiting ratification, and the time is now probably not far distant when the way through Afghanistan will be open and the working of the Chitral forests will at last have become a practical proposition.

(*To be continued.*)



The Shishi Valley, the best forest nullah in Chitral.

Photo: H. L. Wright.
(Copyright.)

Typical Chitral deodar country—very steep for logging, but this forest has actually been worked for logs.

Photo: H. L. Wright.
(Copyright.)

CONVOCATION DAY OF INDIAN FOREST RANGER COLLEGE, DEHRA DUN

The ceremonial close of the 1937—39 Indian Forest Ranger Course took place on 1st April 1939, in the Convocation Hall of the Forest Research Institute. The Honourable Member, Kunwar Sir Jagdish Prashad, very kindly consented to spare the time, among many other more pressing duties, to preside at the distribution of prizes and certificates, which he gave to the students after the following address:

"MR. MASON, MR. RANGANATHAN, LADIES AND GENTLEMEN,

It is a very real pleasure to me to be able to attend this function to-day. I have for some years now been intimately associated both with the Forest Research Institute and with the policy of the Government of India in regard to India's great forest resources and potentialities. It needs no reminder from me to recall to you that the administration of India's forests now lies in the hands of the different Provincial Governments. But the Government of India has still a function to perform in the matter both of research and of co-ordination of effort where the Provincial Governments seek assistance. In this field I believe the Central Government can be of real benefit to Provincial Governments and to India as a whole and it has been a great pleasure to me to observe the keen interest which Provinces and States have evinced in the various lines of research which the Central Government have taken up. I have also been greatly struck by the large number of enquiries which the Research Institute received from all quarters.

Forests constitute an all-India interest of the first magnitude. The area under forests is about a hundred thousand square miles, of which a little over seventy-one thousand square miles are reserved. Nearly 12 million animals graze in our forests and the gross revenue exceeds rupees $2\frac{1}{2}$ crores, a major portion of which is spent in meeting the charges of forest administration. It is of paramount importance that throughout India we should have for the management of this most

valuable property competent and intelligent officers trained in scientific methods to carry out the orders of the various authorities.

Inter-Provincial Interest.—We are all aware that the effects of forest administration are not confined within provincial boundaries. Erosion in one province may mean floods in another. It is essential, therefore, that forest problems should be approached with a wide appreciation of India's needs as a whole and with a full realisation of the havoc that a short-sighted policy and inefficient administration may cause. With the spirit now apparent in the staff and the students of this College, I have no doubt that this wide and generous outlook will be inculcated to the lasting good of India.

As has already been said, this College now caters virtually for all the constituent parts of the Indian Empire. The College could, I believe, hardly be better situated. Climatically, Dehra Dun offers many advantages and is in close proximity to forests where practical administration can conveniently be studied. In addition, it has at its disposal all the resources of the Forest Research Institute, possibly the finest Institute of its kind in the world, and the assistance of experts in the different branches of science with which the competent forest officer must be acquainted. The latter is, I think, a particularly important consideration. It is not even yet widely enough realised that a forest officer needs to be something more than a glorified lumber man. Mr. Ranganathan has already mentioned the varied subjects which the course includes. But it is not enough to have merely book knowledge. Common-sense must guide the application of scientific training to the problems at hand. The comparative isolation in which a forest officer must pass a large part of his professional life puts to a severe and recurring test certain qualities of character: a power to take decisions and assume responsibility, for he cannot always call to his aid the telephone or rush up to headquarters in a motor car; an abiding sense of duty and willingness to work for the good of the country, even if the result of his labours may not be immediately apparent and, therefore, fail to secure popular

recognition. But even if the forest officer were to pass all these moral tests successfully, he cannot really be efficient and do full justice to himself unless he has the stamina and good health to stand the rigours and hardships inseparable from a life in the jungle. I, therefore, applaud the attention given in your curriculum to the students' physical fitness.

I am particularly glad to hear that tours are contemplated in different parts of India. The students will be enabled thereby to take a wider outlook on forestry in India, to which I have already referred.

Guarantee of Employment.—Let me now turn to one or two smaller points of detail. Firstly—and this does to some extent follow logically what I have just been saying—I should like to express my agreement with Mr. Ranganathan as regards qualifications for entrance to this course. The Provinces and States need the very best men they can get for their Forest services. We are doing our utmost to give them a really first-class technical training, but in their own interests we must insist upon minimum qualifications without which the student cannot reap the full benefit of our course. I am, therefore, in full agreement with the insistence upon these qualifications and with the proposal that we should have a somewhat wider field of choice.

Another point to which I wish to refer is the stipulation that private students should be guaranteed employment, before they are admitted to the course. This may seem a somewhat curious stipulation in view of what I have stated about the necessity of obtaining the very best men. But we have been compelled to take other considerations into account. It must be admitted that it is of no value to anybody that there should be qualified men at large in India unable to secure employment of the type for which they have been specially trained. Yet in the past this has been our unhappy experience, and in 1934 Sir Gerald Trevor informed Government that there were still a number of private students, who passed out in 1928 and subsequent years, in search of employment. Their training had obviously been a waste of time and money both

on their part and on ours. We, therefore, decided that private students should not be admitted unless we knew that they would get employment afterwards. I may add that we now have a full complement of students and, while we may regret any individual discouragement that the stipulation may cause, I am satisfied that the College is now performing a service that will be of benefit to India for many years to come.

I should like to refer also to the increasing number of applications which are received from Indian States. In August last it was found that, apart from private students, there were applications from as many as 17 candidates from 13 States. The accommodation here is limited and to allow a class to grow unduly is merely to overtax the staff and reduce the value of the course. We were compelled, therefore, to accept less than the full number of applicants, but I should like to say how greatly I welcome the interest displayed by the Princes in the facilities which we offer. It is, I am sure, an augury with great promise for the future.

You have heard from Mr. Ranganathan the results of the course. I do not propose to comment on them further than to say that they are the best possible evidence of the keenness and devoted work of both staff and students. I offer them both my congratulations. To-day there are 32 students who have completed their training. I wish them all the best fortune in the careers that lie before them and I am confident that wherever their service may take them in India they will look back with affection and regard to Dehra Dun. Thirty-four new students are now joining. To them I take the liberty of extending, on behalf of all present, the most cordial welcome. They will find plenty of hard work here and plenty of good-will and friendship. It is now in their hands to show how they can help India.

One word more. I wish to associate myself with Mr. Ranganathan in his expression of thanks to the Staff and to the many others who have given such ungrudging assistance. It is clear to me that there has been that team work here which is the foundation of success in all such institutions as this.

There could be no happier promise of a flourishing future for this College than the continuance of that spirit. I offer my thanks and my congratulations to all who have worked so hard to build that spirit up and I know full well that all of you have an outstanding example of it in Mr. Mason. He has many duties to perform and perhaps cannot give as much time as he would like to personal contact with the College. But I know that he continues to be a source of inspiration to you and an ever present help in time of trouble. Under his guidance and with the willing assistance of the able staff he has helped to collect, I have no doubt that the Forest Ranger College will go from strength to strength and prove its worth again and again in the widening history of India.

The proceedings had been opened with the following speech by the Inspector-General of Forests, Mr. L. Mason:

SIR JAGDISH PRASHAD, DIRECTOR OF THE INDIAN FOREST RANGER COLLEGE, LADIES AND GENTLEMEN,

It is my privilege to extend to you, Sir, the most sincere welcome and to say how greatly we appreciate your goodness in sparing the time amidst your multifarious and exacting duties to honour us by your presence here to-day.

We know, Sir, that with your intimate and first-hand knowledge of the forests and of the conditions under which the forest officer carries on his work, we can always rely not merely on your personal sympathy and interest but, as I have myself every reason to know, on your active help in all matters which concern our Department.

I can, therefore, assure you, Sir, that your presence here to-day is a source of great encouragement to all of us here, to whom are entrusted the responsible duties of teaching and training the future forest officer.

Before calling on the Director to present his report on the course which is now ending, I would, if I may, Sir, briefly touch on some of the more important features of the past two years' happenings. I would first refer to the changes in the Directorship. In April last, at the close of the first year of the course, we said "Good-bye" to the Director, Mr. Hall,

on his well-deserved promotion to act as Conservator in his own Province—the United Provinces. When the College was re-opened in April 1935, after remaining closed for about three years, Mr. Hall was appointed as its Director. The College was fortunate indeed to have had at this juncture not only one with great organising ability but one possessing—as Mr. Hall does—a special aptitude for teaching and—what is of not less importance—the gift of gaining the confidence and respect of those he teaches. Throughout the time he was Director at the College, his devotion to the interests of the students never failed and his kindness and friendship will always be remembered with gratitude by those who were taught by him. And I know that the students would not forgive me, were I not to include Mrs. Hall in this tribute. I remember, when the news of Mr. Hall's transfer first became known, the students asking me as to what they would do without Mrs. Hall being there to advise and treat them in their various ailments. But it was not only her aid as a skilled doctor that they sought when away in the jungles and out of reach of the College Doctor, but in numerous other ways.

There was indeed no aspect of the College life in which she did not take the most intense interest and she was the friend of all. Her kindness and friendship too, will not be soon forgotten by the students whose privilege it was to know her. You will all, I know, join with me in wishing Mr. and Mrs. Hall all happiness and success in their new post.

Much as we felt the departure of Mr. Hall, we are happily still able to draw on the Indian Forest Service for officers to fill this very important post and thanks to the good offices of the Madras Government, we were fortunate enough to secure the services of Mr. Ranganathan. It is never easy to follow in the footsteps of a distinguished and popular predecessor but Mr. Ranganathan quickly showed that in him we have found a worthy successor and may I say of Mrs. Ranganathan that in her, too, we have a worthy successor to her predecessor. And here I would like to say how glad we are

to see Mr. Ranganathan here to-day restored to health after his severe illness.

With two instructors only, we can ill afford to have either one of them laid aside by illness. Fortunately for us, however, when Mr. Ranganathan fell ill, there was no lack of willing helpers to assist Mr. Madan, on whom the responsibility of the charge of the class devolved. All the projected tours were carried out in full and the practical instruction of the students was not allowed to suffer, thanks to the assistance so readily given to Mr. Madan by the Divisional Forest Officers and staffs of the divisions in which the class toured. Similarly, in the case of the theoretical instruction at headquarters, Mr. Harrison, although already fully occupied with his own duties, at once came forward to help us out of our difficulties by undertaking the lectures on Engineering and Surveying.

To them all, I would tender our most grateful thanks.

I would here desire to add a special word of thanks to Mr. Pring, the Divisional Forest Officer, Kulu, and to Mrs. Pring for all they did for Mr. Ranganathan during his illness. I cannot describe their kindness, both to Mr. and to Mrs. Ranganathan, better than in the words of Mr. Ranganathan: "Mr. Pring could not have treated me with greater kindness or done more for me, had I been his brother."

The main burden of carrying on the course in the absence of the Director has necessarily fallen on the shoulders of the Assistant Instructor, Mr. Madan. All credit is due to him for the efficient manner in which he has discharged his heavy and responsible duties and for thus bringing the course to a successful conclusion.

I would, Sir, also tender my warmest thanks to the officers of the Forest Research Institute, who, in addition to their other duties, have lectured to the students and to those who have so kindly undertaken the examination of the students on our behalf. To the Commandant of the Bengal Sappers and Miners, through whose good offices the students were permitted to receive the most valuable instruction in field

engineering at Roorkee, I would also like to express my warmest thanks. I will not, Sir, anticipate what the Director may have to say in his report beyond stating that I am well satisfied that the standard of the class, both in respect of work and games, has been well maintained. Ten students out of a total class of 32 obtaining honours as compared with eight students out of 27 in the previous course. Physical fitness is an essential qualification for the forest officer and I think a glance round the students sitting here before us will satisfy you, Sir, that this part of the College training has not been neglected. I cannot, Sir, conclude these remarks without referring to the tragic loss, from enteric fever, of student Hazarika. Despite the very best medical attention, and after a most gallant fight, student Hazarika died in the Coronation Hospital on the 6th January 1939. Hazarika was a most popular and at the same time a most promising student. Had he been spared to serve his Province, I have no doubt but that he would worthily upheld the traditions of the College. To his bereaved relations, we offer our most sincere condolences.

I now, Sir, call on the Director to present his report.

The Director's report was as follows:

SIR JAGDISH, MR. MASON, LADIES AND GENTLEMEN,

May I say how glad and honoured we feel that in the pressure of much work Sir Jagdish has found it possible to be present on this occasion. To us, of course, this occasion is important as it marks the ceremonial close of the biennial course (1937—39) of the Indian Forest Ranger College.

This College was founded in 1881 and was known as the Forest School in the old days. At some later date, its name was changed to the Imperial Forest College. This name was retained for several decades and, through many vicissitudes, till some months ago, when it became necessary to change it again, owing to the starting of another college at New Forest with initials which were the same as those of the old Imperial Forest College. I refer to the Indian Forest College. As you all know, the present name of our College is the Indian Forest Ranger College. Except for a short period of 2½ years, when

the College remained closed owing to general restriction of recruitment, the College has an unbroken record of work during a period of 55 years. The students who will presently leave the College to serve in all parts of India and we others who teach in it have, therefore, the honour of belonging to one of the oldest educational institutions in India and to the oldest forest training centre in the East. The reputation of this College—and I make bold to claim it is a great reputation—rests on the record of the men who have passed through its portals.

My distinguished predecessor, Mr. W. T. Hall, reverted to his Province in early April of last year after having served as Director of the College for three years. Mr. U. S. Madan acted as Director for five months when I was absent on leave on medical certificate.

The total number of students who have successfully completed their course of forest training in this College, including those who are about to pass out, is 1,810. Of these, 271 were promoted to gazetted rank, 34 to the Indian Forest Service and the balance to the Provincial Services. One of the students ended his official career as a Conservator. These figures of promotion relate to British India. I regret to say that similar figures for the Indian States are not available, but I have no doubt that an equal proportion of students rose to corresponding positions in the States.

The decision of the Government of Madras to close the Madras Forest College at Coimbatore and to send their students to Dehra Dun for training makes this institution an All-India training centre for Rangers. The only Province which does not at present propose to make use of this College and perfers to make local arrangements for the training of its Rangers is Bombay. These arrangements are, I understand, in the nature of an experiment and it may therefore be that, before long, Bombay also will fall in line with the rest of India in getting its candidates trained in a central institution.

Practical forestry involves a working knowledge of several allied but independent sciences, such as botany, geology, soil science, physics, chemistry, mathematics, engineering and silvi-

culture. It is difficult to see that these various subjects can be taught efficiently by a small staff of instructors in an isolated institution. Access to well organised museums, and the handling of samples, exhibits, herbarium specimens and the like are an essential feature of the course of instruction for forest rangers. The advantages of associating forestry instruction with an university or a research institution are obvious. The Indian Forest Ranger College is fortunate in being situated at Dehra Dun within easy reach of the best equipped forest research institute in the East. The concentration at Dehra Dun of a large collection of the typical flora of India in the gardens at New Forest and the College, the Silviculturist's Demonstration Areas, the numerous museums at the Institute, the technological laboratories connected with wood utilisation and the presence of specialists in the various departments constitute in the sum an advantage which is not available elsewhere in the country and which overrides any minor difficulties there may be in the centralisation of forest training. Admittedly there are difficulties in such centralised instruction in a country of the floristic range of India. The need for familiarising the students with the local problems of the tract in which they will be required to serve and the best methods of dealing with them is fully realised. In order to meet this difficulty, we extend the practical instruction to all the more important types of forests and this year the class has toured as far afield as the deodar and silver fir forests of Kulu, the irrigated plantations of the Punjab, the chir and sal forests of the United Provinces and the teak forests of Bombay. It is proposed to take future classes for a tour in South India forests also, especially those in Madras, for practical work in the evergreen, teak, sandal and dry fuel types of forests. A further advantage of the location of the all-India forest training centre at Dehra Dun lies in the presence of a large number of educational institutions at Dehra Dun and the consequent amenities which are available for inter-collegiate sports.

It has been suggested from time to time that the quality and scope of the instruction given here are in excess of requirements for routine administration of a range and that, conse-

quently, it could be simplified and localised with material financial advantage. I venture to say that this is short-sighted criticism. The improvement and even the mere conservation of the forests entrusted to the Ranger's care are impossible, if his technical equipment does not extend beyond the discharge of his more immediate current duties. A Ranger who is not restrained by sound education is too apt to equate his duties to the production of the most revenue during the time that he may be in charge of the range. "After me, the deluge," he thinks in effect, and the floods may prove to be disconcertingly real after such mismanagement. It is probable that with the present tendency to extend the territorial charges of Divisional Forest Officers, the Range Officer will be called upon to display more initiative and shoulder greater responsibilities than has hithero been the practice. It is of the utmost importance that the technical equipment of the Ranger should not fall short of his increased responsibilities. Many of the men trained in this College will, I have no doubt, be in course of time promoted to hold charge of divisions and it is important that the education they have received here should stand them in good stead. A purely provincial outlook is especially dangerous in the practice of forestry in India where agriculture is the main national industry and the major rivers have a habit of wandering through several provinces before they reach the sea. The Range Officer constitutes the backbone of forest administration and it is surely no small thing that the men trained in this College form a great and far-flung brotherhood with common ideals and common traditions, working to a common purpose throughout the country.

Admissions to the College are regulated by a qualifying examination held simultaneously in a number of centres, the subjects being English Composition, Dictation and Mathematics. The standard of the papers set is that of the School Final or Matriculation examination. Instruction in the College is given in English and an adequate knowledge of that language is essential if the student is to benefit by the course. A sound knowledge of elementary mathematics is required of the

student in order that he may follow the lectures in Mensuration, Management and Engineering. The number of candidates with high qualifications on paper who fail in these elementary examinations is amazingly high and this is the justification for the insistence laid on an entrance examination. The largest percentage of failures is usually in mathematics. The minimum qualification required of candidates is a pass in the Matriculation or equivalent examination, but higher qualified men are readily forthcoming and the present class is composed of one M.A., seven B.As., five B.Scs. and eleven Intermediates. One of our difficulties in the entrance examination is the very small number of candidates who sit for the examination from the States. A State desirous of deputing one student to the College often permits only one or two candidates to sit for the examination and it has frequently happened that of the small number so examined, none qualified, with the result that no student could be accepted from the State in question. It is very desirable that a sufficient number of candidates should be allowed to appear for the examination for each vacancy and, if I may suggest a figure, I would say that some six candidates should be allowed to contest each vacancy, subject, of course, to their possessing the prescribed minimum qualification.

It has been the practice since the College resumed work after a short period of closure, to take in one batch of students, complete their training, which is spread over two years, and then to recruit the next batch. This procedure was adopted for reasons of economy, as it enabled the College to be run with skeleton staff. The procedure has little else to recommend it. The building up of an unbroken tradition, the beneficial intercourse of senior and junior students, healthy rivalry in games between separate classes, all become impossible under a system where there is only one class in residence. A further drawback to biennial recruitment is that the number of students in the class is more than we consider the optimum for practical field instruction. It is difficult to arrange for the transport and accommodation of such a large class on

the tours and to ensure that each student gets the full benefit of the practical instruction in the field. Similarly, a very heavy burden is thrown on the two instructors who have to teach a large number of subjects, whereas with annual admissions such work would be shared by four instructors who would thus be able to deal more thoroughly with their subjects and give more personal attention to the students than is possible at present. Efforts were made this year to revive the system of annual recruitment, but the response from the Provinces and States was not sufficiently encouraging. We hope that with the coming in of the South Indian students, the situation will change and that it will then be possible to revert to normal annual admissions.

The College does not admit private students, that is, students who are not the nominees of a government or administration, unless they can produce a guarantee of employment on successfully completing the course. The practice of taking in private students was stopped in 1929, on account of the difficulty experienced in finding employment for them. There is no open market for the qualifications of a Ranger and we consider it undesirable to add a new species to the already large order of the "educated unemployed."

I may be permitted to describe in brief outline the nature of the Ranger's Course. In addition to forestry, by which I mean silviculture, forest management, forest protection and utilisation, the subjects taught are forest engineering including surveying and drawing—a very important subject—botany, physical science, elementary mathematics (this is necessary for the reason I have already stated), forest law, forest accounts and office procedure, mycology, plant ecology and entomology. May I take this opportunity of expressing the gratitude of the staff and students of the College for the lectures given by Dr. Bor on ecology, Mr. Laurie on teak, Dr. Bagchee on mycology and Dr. Chatterjee on forest entomology. We are indebted to Mr. Harrison for completing the lectures in engineering during the period that I was on leave. I desire to thank Messrs. Bhargava, Nagle, Limaye and Dr. Kapur for

demonstrating to the class the work done in the sections of the Utilisation Branch. A severely practical bias is deliberately given to the course of instruction and no pains are spared to impress on the students that it is their business to do things and not merely to talk about them. Practical instruction during tours is an integral part of the course and the class has toured extensively in the forests of Dehra Dun, Saharanpur, Chakrata, Almora, Kulu, Chichawatni, Changa Manga, Haldwani, Pilibhit, Gorakhpur and Thana. The class has undergone training in practical field engineering under the auspices of the Commandant of the Bengal Sappers and Miners at Roorkee and I take this opportunity of thanking him for the kindness and courtesy shown to us. Practical training in the preparation of working plans was given to the class at Banbassa, where, by the courtesy of the Working Plans Conservators of the United Provinces, the students prepared a working plan for a small block of forest.

Games and physical training are given much attention. The College won the Wali Cup Hockey Tournament in 1938. The standard of the Class in tennis, football, volleyball and badminton was good. In H. C. Pant the class possesses a champion athlete with a distinguished university record in athletics. Combined sports meetings of the College and the Forest Research Institute are held annually in hockey, cricket, football, tennis and athletics. In 1938 the College won in hockey and football and carried away a large share of the prizes for tennis and athletics. The Championship Cup was won by Pant.

It is my melancholy duty to record the death of one of our students, K. C. Hazarika, from Assam, through enteric fever. He was a cheerful and popular student and would, I have no doubt, have made an excellent Ranger had he been spared.

We are greatly indebted to our President, Mr. Mason, for the great personal interest he takes in the affairs of the College and for the constant guidance he gives in the running of the College.

I now turn to the results.

INDIAN FOREST RANGER COLLEGE, DEHRA DUN.

FINAL RESULTS OF THE 1937-39 RANGER COURSE STUDENTS

Honours

1.	B. N Nandi	...	Bihar.
2.	K. H. Chati	...	C. P.
3.	K. P. Shukla	...	C. P.
4.	S S. Pandit	...	C. P.
5.	B. S. Sidhu	...	C. P.
6.	J. R. Shairani	...	Tonk
7.	Manohar Singh	...	U. P.
8.	H. C. Pant	...	U. P.
9.	Mohammad Yusuf	...	N. W. F. P.
10.	K. D. Ahmed	...	Assam.

Higher Standard

1.	M. C. Gairola	...	U. P.
2.	K. N. Singh	...	U. P.
3.	S. K. Roy	...	Bihar.
4.	S. Qureshi	...	U. P.
5.	V. S. Gandotra	...	Kashmir.
6.	S. S. Gergan	...	Kashmir.
7.	P. L. Shrivastava	...	C. P.
8.	S. G. Panda	...	Orissa.
9.	G. P. Nigam	...	Rewa.
10.	Gopi Nath	...	Chamba.
11.	A. S. Misra	...	Rewa.
12.	Mir Badshah	...	Kashmir.
13.	Mohammad Hanif	...	Kashmir.
14.	S. Mumtaz Ali	...	C. P.
15.	W. D. Ahmed	...	Punjab.
16.	Abdul Aziz Khan	...	Bengal.
17.	R. K. Pandeya	...	Rewa.
18.	Nasrullah Khan	...	N. W. F. P.
19.	S. C. Mitra	...	Bengal.

Lower Standard

1.	S. P. Garg	...	Rewa.
2.	Ata Mohammad Khan	...	Kashmir.
3.	Mohammad Haider Khan	...	Kashmir.

INDIAN FOREST RANGER COLLEGE, DEHRA DUN.

FINAL RESULTS OF THE 1937-39 RANGER COURSE STUDENTS

HONOURS

1.	B. N Nandi	...	Bihar.
2.	K. H. Chatı	...	C. P.
3.	K. P. Shukla	...	C. P.
4.	S S. Pandit	...	C. P.
5.	B. S. Sidhu	...	C. P.
6.	J. R. Shairani	...	Tonk
7.	Manohar Singh	...	U. P.
8.	H. C. Pant	...	U. P.
9.	Mohammad Yusuf	...	N. W. F. P.
10.	K D. Ahmed	...	Assam.

HIGHER STANDARD

1.	M. C. Gairola	...	U. P.
2.	K. N. Singh	...	U. P.
3.	S. K. Roy	...	Bihar.
4.	S. Qureshi	...	U. P.
5.	V. S. Gandotra	...	Kashmir.
6.	S. S. Gergan	...	Kashmir.
7.	P. L. Shrivastava	...	C. P.
8.	S. G. Panda	...	Orissa.
9.	G. P. Nigam	...	Rewa.
10.	Gopi Nath	...	Chamba.
11.	A. S. Misra	...	Rewa.
12.	Mir Badshah	...	Kashmir.
13.	Mohammad Hanif	...	Kashmir.
14.	S. Mumtaz Ali	...	C. P.
15.	W. D. Ahmed	...	Punjab.
16.	Abdul Aziz Khan	...	Bengal.
17.	R. K. Pandeya	...	Rewa.
18.	Nasrullah Khan	...	N. W. F. P.
19.	S. C. Mitra	...	Bengal.

LOWER STANDARD

1.	S. P. Garg	...	Rewa.
2.	Ata Mohammad Khan	...	Kashmir.
3.	Mohammad Haider Khan	...	Kashmir.

THE FOREST RESEARCH INSTITUTE AND COLLEGE ANNUAL SPORTS, 1939

By U. S. Madan

The combined Forest Research Institute and College Sports were held on Friday, the 31st March 1939, at the New Forest. The beautiful lawns to the north of the main buildings were used for the track. The President and the gazetted Staff of the Forest Research Institute and College were "At Home" to the staff of the local educational institutions including the Indian Military Academy, the Prince of Wales's Royal Indian Military College, the Dun Public School, the St. Joseph's Academy and to their personal friends, which included most of the officials of the station and gentry of the town.

The arrangements for the "At Home" were made by Mrs. Mason, who was assisted by a committee of ladies and the tea was served in the open under the shade of the mango trees. Dr. N. L. Bor, assisted by a committee, was in charge of the Sports.

The Staff of the Forest Research Institute and students of the Indian Forest Ranger College competed for the Sports. The students of the Indian Forest College were on tour and, therefore, could not take part.

A slow cycle race was substituted for the tug-of-war this year, and it provided more interest than the tug-of-war. Instead of the egg-and-spoon race for the ladies, this year there was the potato race, which created a good deal of amusement. Besides the various races and the other interesting events like sack scrimmage, the obstacle race and the spar fighting, there were the officers' handicap race, the inferior staff race and two races for children. The children's races, the ladies' race, the officers' race and spar fighting were much appreciated by the spectators.

The prizes for the various events were divided almost half and half between the Staff of the Forest Research Institute and the students of the Indian Forest Ranger College. The championship cup was won by Student Harish Chandra Pant of the Indian Forest Ranger College. The relay race between the Forest Research Institute and the Indian Forest Ranger College was won by the College.

Our thanks are due to Captain G. Hawks, who discharged the duties of starter most admirably.

Mr. U. S. Madan, assisted by a committee, managed the tennis and badminton tournaments. This year mixed badminton was introduced and it is hoped that it will form an annual event of the tournament. As there were not enough entries for the mixed tennis, it was run on a league system.

The tournaments for football, hockey, cricket and volleyball were held under the auspices of the New Forest Club. Various sections and branches of the Forest Research Institute and College took part in these tournaments. Besides the outdoor games, the tournaments for the indoor games, *viz.*, chess, carrom, auction bridge and darts were held by the New Forest Club.

In tennis, a number of interesting and well contested matches were held. The open singles was very closely contested.

The programme was kept to time and Mrs. Mason gave away the prizes.

After the prize distribution, the function came to a close with three cheers for Mrs. Mason.

The Sports Committee deserves much credit for bringing the function to a very successful end.

RESULTS

The names of successful competitors are given below:

Long Jump	M. S. Rana (F.R.I.). H. C. Pant (I.F.R.C.).
Throwing the Cricket Ball ...	M. S. Rana (F.R.I.). Indra Pal (F.R.I.).
Putting the Weight ...	S. K. Roy (I.F.R.C.). Nasrullah Khan (I.F.R.C.).
High Jump	H. C. Pant (I.F.R.C.). K. Kerr (F.R.I.).
100 Yards Race	H. C. Pant (I.F.R.C.). G. S. Rana (F.R.I.).
Hurdles Race	H. C. Pant (I.F.R.C.). Indra Pal (F.R.I.).
Sack Scrimmage	Mohd. Yusuf (I.F.R.C.). S. S. Gergan (I.F.R.C.).
220 Yards Race	H. C. Pant (I.F.R.C.). G. S. Rana (F.R.I.).

Slow Cycle Race ...	... S. Qureshi (I.F.R.C.). S. P. Sahi (F.R.I.).
Relay Race ...	... Indian Forest Ranger College.
Officers' Race ...	... Dr. N. L. Bor (F.R.I.). Mr. L. Mason (F.R.I. & C.).
Potato Race (Ladies)	... Mrs. Ramaswami. Mrs. Mason.
Half Mile Race ...	... Indra Pal (F.R.I.). Mohd. Hanif (I.F.R.C.).
Spar Fighting ...	... S. K. Roy (I.F.R.C.).
Obstacle Race ...	... S. S. Gergan (I.F.R.C.). Indra Pal (F.R.I.). Nur-ul-Hasan (F.R.I.).

OUTDOOR GAMES

1. THE FOREST FOOTBALL CHALLENGE CUP

(Presented by Sir Alexander Rodger.)

Winners

F.R.I.

2. THE MASON-JASPAL HOCKEY CUP

Winners

F.R.I.

3. SEAMAN CRICKET CUP

Winners

F.R.I.

4. VOLLEYBALL CUP

Winners

F.R.I.

5. R. K. BANERJI MEMORIAL CUP FOR BADMINTON

Winners

G. N. Singh (I.F.C.).

N. S. Kaikini (I.F.C.).

Runners-up

K. Kerr (F.R.I.).

Dev Raj Sud (F.R.I.).

6. TENNIS, MEN'S OPEN SINGLES

(Cup presented by Mr. A. D. Blascheck.)

Winner

S. K. Kukreti.

Runner-up

S. Qureshi.

7. TENNIS, MEN'S OPEN DOUBLES

(Cup presented by Mr. L. R. Sabharwal.)

Winners

S. K. Kukreti.

Latif-Ullah.

Runners-up

K. N. Tandon.

L. N. Taneja.

8. MEN'S HANDICAP SINGLES

(Cup presented by Mr. W. T. Hall.)

Winner

S. K. Kukreti.

Runner-up

U. S. Madan.

9. MEN'S HANDICAP DOUBLES

(Cup presented by Dr. N. L. Bor.)

Winners

S. K. Kukreti.

Latif Ullah.

Runners-up

K. N. Tandon.

L. N. Taneja.

10. MIXED TENNIS

(Cup presented by Sir Gerald Trevor.)

Winners

Mrs. Mason.

V. S. Gandotra.

11. MIXED BADMINTON

Winners

Mrs. Madan.

S. K. Roy.

Runners-up

Mrs. Mason.

Mr. S. C. Mitra.

INDOOR GAMES

12. GAME OF TWENTY-NINE

Narain Singh Rawat

Dalip Singh.

13. AUCTION BRIDGE

Madhawa Nand.

Amar Singh Bist.

14. CARROM

Gopi Nath Kapur.

J. N. Banerjee.

15. CHESS

Pandit Vishnu Prasad.

16. DARTS

Mrs. Mathur.

17. PING-PONG

N. S. Sissodiya.

HOST PLANTS AND THE SPIKE DISEASE OF SANDAL

BY RAO SAHIB S. RANGASWAMI,
Research Ranger, Denkanikota,
and
A. L. Griffith, M.A., M.SC.
Provincial Silviculturist, Ootacamund.

Summary.—1. Floristic surveys in spiked areas and in patches that had remained healthy in such spiked areas for many years showed great differences in the floristic composition of these two types of areas.

2. Experiments on plants in pots showed great variations in the extent of haustorisation of sandal on different species of host plants.

3. Experiments on the grafting of spiked leaf tissue on to healthy sandal plants in pots showed that sandal associated with some species of hosts possesses a very high degree of resistance to the disease.

4. Experiments in the forest with natural infection by insects confirmed these indications of resistance not only in the species but also very largely in the degree of resistance.

5. Large-scale controlled experiments in the forest in removing susceptible hosts and replacing them with resistant hosts showed that such a procedure greatly reduces spike incidence. Such work can also be a profitable operation by reason of revenue obtained from the newly introduced hosts themselves.

6. Control measures have been devised by means of which new attacks of the disease can be controlled and eradicated.

Therefore, work on the host plants of sandal and their classification according to the degree of haustorisation and the degree of resistance to spike which they impart to sandal parasitic on them, is well worth while for both academic and economic reasons.

Introduction.—This short article on the work done in Madras on this subject and the conclusions reached from it has been written in response to the request of the Editor of the *Indian Forester* in the November 1938 issue (page 669).

The work done in Madras has been from a rather different aspect from that of Sri Venkata Rao and, therefore, a brief description of the work is necessary before summarising where we agree with and where we differ from his conclusions.

Most of the work described has been published year by year in the "Report on Silvicultural Research in the Madras Presidency." A description of the way in which new outbreaks of the disease can be and are being controlled and eradicated has been published as an *Indian Forest Record* (Silviculture Series Vol. III, No. 7), but as in his list of references at the conclusion of his article Sri Venkata Rao makes no mention at all of any of this published work, it must be assumed that he is not acquainted with it. A brief summary of this work is therefore necessary.

Floristic surveys.—Very early in the study of spike it was realised that a sandal forest was attacked by the disease to very different degrees in different parts of it. In one and the same forest even though the disease had been prevalent for a long time, in parts, the sandal remained practically unaffected, whereas in other parts it has been almost completely wiped out.

In consequence, many floristic surveys of such areas to try and find out the differences in the flora between such diseased and healthy patches of the same forest were undertaken. These surveys quickly showed that there were great differences between such areas and, although of course surveys in different places showed great variance of species, yet there were general resemblances which appeared to connect the diseased areas with certain types of hosts and the healthy areas to other types.

A typical example of such a survey is briefly described. The area is one reserved forest of limited extent in Salem North Division. Spike has been virulent in this forest now for 22 years and yet many parts of it are still unaffected.

The floristic survey of these areas showed that the *spike areas are characterised by*:

1. A complete absence of—

   Carissa paucinerva; Holarrhena antidysenterica; Pittosporum floribundum; Chlorodendron serratum; and *Cippadessa fruticosa.*

2. A preponderance of—

	Spike areas.	Healthy areas.
Phyllanthus polyphyllus ...	375	14
Acacia pennata	153	5
Atlantia monophylla	135	3
Lantana camara	4,747	284

3. An exclusive presence of—

	Spike areas.	Healthy areas.
Acacia sundra	27	0
Pterolobium indicum	18	0
Chloroxylon swietenia	85	0
Indigofera mysorensis	19	0
Gmelina asiatica	11	0

4. A diminished occurrence of—

	Spike areas.	Healthy areas.
Dioscoria oppositifolia	49	164
Erythroxylon monogynum	68	124
Memicylon edule	26	229
Jasminium sp.	97	329
Scutia indica	43	116
Toddalia aculeata	52	148
Dodonea viscosa	253	603

5. And, of course, by a very much larger number of—

	Spike areas.	Healthy areas.
Dead trees	143	32
Spiked sandal trees	7	0

Such observations as the above naturally turned our attention to a detailed study of the host plants of sandal.

Extent of parasitism of sandal on different species of hosts.—The first aspect studied was a measure of the extent of parasitism of sandal on different species of host plants. Many species of hosts were studied and, in the results given in the following table, no species is included unless it has been tested with a *minimum* of 30 cases and results averaged.

The sandal and the individual host plants were grown together in pots and extra hosts such as grass and weeds were excluded as far as possible. When the combinations were three years old, they were very carefully extracted from the pots, the soil was washed off the roots and the actual number of haustorial connections counted.

The host plants were differentiated as (A) Poorly parasitised (having less than 25 haustorial connections); (B) Moderately parasitised (having 25 to 100 connections) and (C) Well parasitised (having more than 100 connections). The list is as follows;

Poorly parasitised (below 25 haustoria)	Moderately parasitised (25 to 100 haustoria)	Well parasitised (over 100 haustoria)
Azima tetracantha	*Ixora parriflora*	*Pongamia glabra.*
Flueggea leucopyros	*Strychnos nux vomica*	*Mundulea suberosa.*
Aloes	*Flacourtia sepiaria*	*Acacia farnesiana.*
Psidium guayava	*Scutia indica*	*Murraya koenigii.*
Cæsalpini coriaria	*Jatropha curcas*	*Acacia pennata.*
Grevillea rebusta	*Butea frondosa*	*Azadirachta indica.*
Rhus mysorensis	*Bambusa arun inacea*	*Cajanus indicus.*
Carica papaya	*Zizyphus jujuba*	*Ocimum sanctum.*
Eugenia jambolana	*Zizyphus œnoplia*	*Capsicum frutescens.*
Opuntia dillenii	*Ehretia buxifolia*	*Terminalia arjuna.*
Euphorbia sp.	*Dichrostachys cinerea*	*Casuarina equisetifolia,*
Alœ barbadensis	*Melia dubia*	*Ruta graveloens.*
Cudrania javanensis	*Citrus medica*	*Pittosporum floribundum*
Thevetia nerifolia	*Schleichera trijuga*	*Albizzia amara.*
Webera corymbosa	*Wrightia tinctoria*	*Solanum seaforthianum.*
Diospyros berberis	*Flemingia congest*	*Lantana camara.*
Jatropha gossypifolia	*Tamarindus indica*	*Toddalia aculeata.*
Carissa carandus	*Breynia rhamnoides*	*Ficus* sp.
Proticum caudatum	*Vitex pubescens*	*Acacia cyanophylla.*
Sanseverira zeylanica	*Euphorbia tirucalli*	*Cassia siamea.*
Kalanchœ floribunda	*Capparis sepiaria*	*Acacia suma.*
Plumbago zeylanica	*Bauhinia racemosa*	*Pterocarpus marsupium.*
Cedrela toona	*Dodonea viscosa*	*Dalbergia latifolia.*
Prosopis juliflora	*Chloroxylon swietenia*	*Holarrhena antidysenterica.*
Gmelia arborea	*Bassia latifolia*	*Dalbergia sissu.*
	Tectona grandis	*Cassia lævigata.*
	Stephegyne parviflora	*Cordai myxa.*
	Erythroxylon monogynum	*Acacia ferruginea.*
	Zizyphus trinervia	*Pithecolobium dulce.*
	Argyriea cuneata	*Lycopersicum esculentum.*
	Chikrasia tabularis	*Anogeissus latifolia.*
	Adenanthera pavonina	*Cassia fistula.*
	Murraya exotica	*Cassia montana.*
	Semecarpus anacardium	*Tephrosia candida.*
	Holoptelia integrifolia	*Grewia orientalis.*

These results indicate that there is great variation in the amount of parasitism by sandal on different species of host plants. Though in the forest a certain number of plants may exist round sandal apparently as hosts, there is the probability of many of them not actually serving as hosts.

Killing of the host by sandal parasitisation.—The question of whether the sandal kills the host or not depends on whether the host is easily and well parasitised and also on the relative sizes and development of the host and the sandal at the time haustorisation starts. Hosts which are well parasitised can easily be killed out if they are not given a sufficient start in life before the sandal is introduced.

Examples of this are given in the following table of results of a few typical experiments that have been done. In endeavouring to get comparative results it was essential to try and eliminate the age factor and to do this two-year old stumps or transplants of the host plants and two-year old sandal stumps were introduced together in pots. In the case of dhall (*Cajanus indicus*), however, two-month old plants had to be used.

Name of host.	No. of combinations.	No. of hosts which died after—				
		Four months.	Six months.	Eight months.	Ten months.	One year.
Cassia siamea ..	12	..	2	8	2	..
Acacia farnesiana ..	20	..	5	15	..	..
Ruta graveloens ..	10	..	8	2	..	..
Pithecolobium dulce ..	10	..	..	10	..	..
Pongamia glabra ..	12	..	..	..	2	4
Melia azadirach (*Persian Neem*) ..	14	2	8	3	1	..
Zizyphus jujuba ..	8	..	..	..	..	7
Jatropha curcas ..	8	..	..	..	..	*
Mundulea suberosa ..	25	1	15	5	4	..
Cajanus indicus ..	20	10	10	..	..	..
Ocimum sanctum ..	12	4	8	..	..	..
Ocimum canum ..	12	5	7	..	..	..

It is to be noted that in the above list those species which were killed out by the sandal in the shortest time in general are those which are well parasitised as is seen from the previous list.

* All lived more than one year.

It must, of course, also be remembered that the sandal plants will die out if attempts are made to grow them with species on which they will not haustorise. In all these experiments it is essential that on the death of either the sandal or the host, the combination should be dug up carefully to see to what extent haustorisation has successfully been accomplished.

We thus see that in work with sandal we should concentrate on those hosts which are well parasitised and we should give them a sufficient start in life so that they are able to support the sandal in its full vigour and not be killed out.

The influence of host plants on spike disease.—We next turned our attention to whether hosts influence the degree of resistance or susceptibility to the disease of the sandal parasitic on them.

Before going on to describe the experiments done, it is necessary to mention how the methods were decided on. As a result of work with many thousands of grafts of twig, leaf, bark and bud material, we came to the conclusion that the leaf graft is the most satisfactory to use as a standard test. It is the most easily done and the most certain and most consistent in its results. The results of typical experiments on different methods of grafting are as follows:

Nature of graft	Percentage of plants that developed spike due to the graft
Scion (or twig) grafts	23 per cent.
Bud grafts	29 per cent.
Bark grafts	45 per cent.
Leaf grafts	70 per cent.

(It should be noted that in this we entirely disagree with Sri Venkata Rao who maintains that a twig graft is the best test.)

In our work, in our "standard" test of grafting with leaf material we have fixed a standard dose which consists of a definite quantity of material taken from a definite part of leaves of a definite type. We are, therefore, reasonably sure that all plants grafted in this way receive the same chance of developing the disease.

Relative resistance to artificial infection with the disease by leaf grafting.—Sandal plants growing in pots with individual hosts were grafted with spiked leaf tissue by the standard test. In the first

experiments, 30 combinations of each of 27 host species were tested. Results were so striking that the experiments were repeated and extended in the cases of host plants that we were likely to use in experimental and field work. These repetitions (and in the case of 16 species over 200 combinations of each have been tested) confirmed our initial results.

Results are best seen in the following table:

Serial No.	Species.	No. of combination grafted.	No. that resisted the disease.	Percentage of comparative resistance.
*1	*Acacia farnesiana* ..	30	4	13
2	*Dodonea viscosa* ..	30	28	93
*3	*Ruta graveolens* ..	30	30	100
4	*Pithecolobium dulce* ..	30	10	33
5	*Pongamia glabra* ..	30	5	17
*6	*Lantana camara* ..	30	0	0
*7	*Azadirachta indica* ..	30	30	100
*8	*Cassia siamea* ..	30	29	97
*9	*Semecarpus anacardium* ..	30	30	100
*10	*Strychnos nux vomica* ..	30	30	100
*11	*Zizyphus jujuba* ..	30	30	100
*12	*Murraya kœnigii* ..	30	28	93
13	*Dalbergia sissoo* ..	30	30	100
14	*Dalbergia latifolia* ..	30	5	17
15	*Jatropha curcas* ..	20	9	45
*16	*Bambusa arundinacea* ..	30	30	100
*17	*Erythroxylon monogynum* ..	30	30	100
18	*Albizzia oderatissima* ..	30	12	40
19	*Acacia leucophloea* ..	30	8	27
*20	*Mundulea suberosa* ..	30	2	7
*21	*Cajanus indicus* ..	30	0	0
*22	*Terminalia arjuna* ..	30	20	67
23	*Zizyphus œnoplia* ..	30	15	50
*24	*Ocimum sanctum* ..	30	4	13
25	*Ocimum canum* ..	30	20	67
26	*Chloroxylon swietenia* ..	30	16	53
*27	*Melia azadirach* (*Persian Neem*) ..	30	0	0

Relative immunity to natural infection with the disease.—Having got the above results with the artificial infection of plants in pots, the next step was to test whether this held good in the case of the natural infection of trees in the forest.

*Note.—In the case of these combinations more than 200 in each have been tested with the same result.

Combinations of sandal with 26 species of host plants were raised in a virulently spiked area. In order that the sandal should, as far as is practicable, be confined to one host species, the combinations were raised on big earthen mounds six feet by four feet by three feet. This excluded extra hosts except such as a little grass and weeds, though these were removed as soon as they appeared.

Results were concluded after five years by which time the plants were growing too big for the mounds and it was likely that they were beginning to haustorise on plants beyond the mounds (this was later tested by digging them up).

Results are seen in the following table:

Sl. No.	Combinations.	Number of combinations.	Number spiked.	Percentage of comparative resistance.
1	*Acacia farnesiana* ..	7	7	0
2	*Aristolochia indica* ..	4	4	0
3	*Dodonea viscosa* ..	4	1	75
4	*Pithecolobium dulce* ..	4	4	0
5	*Pithecolobium saman* ..	4	3	25
6	*Lantana* ..	7	7	0
7	*Pongamia glabra* ..	5	5	0
8	*Murraya koenigii* ..	5	0	100
9	*Dalbergia sissu* ..	4	3	25
10	*Mundulea suberosa* ..	5	5	0
11	*Cajanus indicus* ..	5	5	0
12	*Melia azadirach* (*Persian neem*) ..	6	6	0
13	*Acacia suma* ..	5	5	0
14	*Murraya exotica* ..	5	4	20
15	*Toddalia aculeata* ..	5	4	20
16	*Zizyphus oenoplia* ..	4	3	25
17	*Terminalia arjuna* ..	8	6	25
18	*Chloroxylon swietenia* ..	4	2	50
19	*Zizyphus jujuba* ..	4	1	75
20	*Albizzia amara* ..	5	4	20
21	*Casuarina equisetifolia* ..	4	3	25
22	*Cassia siamea* ..	15	1	93
23	*Strychnos nux vomica* ..	4	0	100
24	*Melia indica* (*Azadirachta indica*) ..	10	0	100
25	*Semecarpus anacardium* ..	3	0	103
26	*Erythroxylon monogynum* ..	3	0	100

The various species were randomised throughout the areas so that all should have an equal chance of infection.

Numbers are admittedly small but the above figures are a very striking confirmation of those given in the previous table for artificial infection.

Practical application in the forest.—(*a*) In the forest it is impossible to ensure that a sandal tree has only a particular species as a host and in consequence, in order to try and test the applicability of the above work to practical forestry, randomised sub-plots of one acre each were laid out in a virulently spiked area. In each sub-plot 200 sandal plants were established by planting.

Two treatments were applied:

A.—In which only resistant hosts were retained and all others removed. These were supplemented by introducing more hosts by sowing or planting similarly resistance-imparting species.

B.—In which only susceptible hosts were detained and all others removed. These were supplemented by introducing by sowing or planting similarly susceptible species.

At the end of six years the spike manifestation incidence in the resistance and susceptible plants was in the proportion of one to four. (It is to be noted that one-acre plots are too small and the spike in the resistance plots was almost entirely due to edge effect.)

(*b*) A further large-scale experiment was also started with five-acre sub-plots. In this experiment, three treatments were used:

(A) Resistant hosts retained, susceptible hosts removed, and further resistant host introduced.

(B) Susceptible hosts retained, resistant hosts removed, and further resistant hosts introduced.

(C) Control plots—no treatment.

The area was selected in the direction of spread of a spike outbreak. So far, after seven years, the proportion of manifestation of spike is:

A: B: C: : 0: 32 : 12.

It remains to be seen how these two experiments progress in the future, but it appears that a high degree of relative resistance has been introduced by Treatment A.

Control of new outbreaks of spike disease.—A successful method for the control and eradication of new outbreaks of the disease has

been evolved from the research on this disease. The control methods are now in general use and are successful at a reasonable cost. They are described in *Indian Forest Records*, Silviculture, Vol. III, No. 7.

It is of interest to note that these control measures are a *practical* application of results obtained by an academic investigation which, it has often been suggested, was unlikely to produce results of use to the practical forester.

Conclusions and comparison with those of Sri Venkata Rao.—

1. Our results show that certain host plants do impart a high degree of relative resistance to spike to sandal plants parasitic on them. This degree of resistance is in general the same in the case of natural as in artificial infection.

(We do not claim *absolute* immunity as this is a degree of resistance almost unknown in the study of diseases. Even in such cases as the human diseases of small-pox, enteric, plague, etc., which have been so very intensively studied, absolute immunity is not obtained by such measures as vaccination or inoculation!)

2. This relative immunity imparted by hosts can be made of practical use in the field in substantially reducing spike incidence as is shown by large-scale experiments.

3. We agree with Sri Venkata Rao that little can be done in the case of large areas already virulently spiked but in areas of natural sandal or sandal plantations where spike has not yet appeared we can do a very great deal by the regulation of the host species to render the areas relatively resistant to the disease, and, with our control measures, we can adequately deal with any disease that appears.

4. In the case of new sandal plantations they should be raised with the most suitable hosts from the start.

5. The hosts to be introduced are those on which sandal haustorises well, which impart a high degree of resistance to spike, and which are in addition economically profitable.

(Examples of such hosts which have been introduced and which themselves have quickly paid for their introduction are *Cassia siamea* which is used for fuel lopped for manure leaves and also bamboos.)

6. Such introductions greatly lessen the intensity of an outbreak if one does start and hence reduces the cost of control measures and makes their success more certain. These host introductions also

greatly improve the vigour and hence the growth of the sandal and they can be profitable operations in themselves.

In conclusion, we would say that we do not agree with the general pessimistic conclusions of Sri Venkata Rao with regard to work on the spike problem from the aspect of the host plants. We believe that our work shows that there is every cause for optimism and, in addition, as the introduction of some of the host species, which have the characteristics we want to introduce, has already been economically profitable, from this aspect alone it is worth going on with in these times of financial stringency.

SOIL EROSION AND GRAZING PROBLEMS IN BOMBAY

By R. W. Inder

A recent American publication* on the above subject begins with a chapter on the significance of erosion. "What takes Nature hundreds, or perhaps thousands of years to manufacture, man can, and often does, destroy almost overnight by haphazard use and improvident husbandry. How else are we to interpret the wholesale cutting and ravaging of our forests, the widespread removal of grasses from hill-sides to make way for cultivated crops, the senseless over-grazing of pasture lands, and the inadequate safeguarding of vast tracts of forests and overcut lands from denuding fires?"

It then gives statistics based on careful experiments. Fifty million acres of cultivated land totally ruined and abandoned in 1935 against 10 million acres in 1910; and partial stripping of the top-soil on 100 to 150 million acres of remaining cultivated soil. Two hundred and fifty million tons of dissolved matter, containing sixty-five million tons of plant food is estimated to be carried to the oceans in a year. It also states that 165 millions of acres of public lands have lost from 40 to 50 per cent. of their productivity.

America, nationally, has become aware of the enormous loss by erosion and has taken very intensive preventive measures, devoting large grants to research and to controlling measures. India, too, has heard, faintly, the urgent call for action given by forest officers and

* "Soil Erosion and Its Control," Q. C. Ayres. Mcgrain-Hill Book Co.

engineers, but little beyond assembling conferences has been done. In the United Provinces and in the Punjab, some little has been done by the Forest Department, but the root of the matter—excessive grazing and forest destruction—has hardly been touched.

What of Bombay? Old forest reports show that the officers were fully aware of the evil, but they pointed chiefly to the silting of the waterways and harbours from Surat to Bhatkhal; they were less concerned about the loss of soil from the steep slopes of the Ghats, and less still about the erosion of the Deccan Hills, as the blocking of the coast harbours pointed their moral. But they were aware that the soil of the Bombay Presidency was rapidly being eroded. Where rice was cultivated this was not obvious, for the terracing guarded against erosion and, to some extent, the depth of soil in such places was increased, and is increasing by deposition. It is the dry crop and grass area which should rouse an alarm, if we are agriculturists, and our attention should be transferred to the Deccan mainly though not neglecting the *rabi* and grass areas in the Konkan.

In the book just quoted, it is given as a fact established by measurement, though it is self-evident, that forests form practically a complete protection against erosion; that they ease the intensity of run-off of rain water in wet weather; that they increase the subsoil water content and so lengthen the period of run-off. A crop of perennial grasses is almost as efficient.

What is the general condition of the Deccan? Apart from a narrow fringe along the Ghats in charge of the Forest Department, it is a country woefully denuded of trees and woefully overgrazed, or unwisely grazed. Nothing in the past was so vigorously attacked as an attempt of the Forest Department to point the necessity for grazing lands, and to reboise the hills. The latter was really the business of the Revenue Department, before the Agricultural Department came into active being. The people resisted any curtailment of privileges, though their well-being lay in a restriction, and the Revenue Department supported them. In Ahmednagar, thousands of acres were removed from the control of the Forest Department in Sir G. Clarke's time; and in Poona and Satara Districts thousands of acres, which were left within the demarcation line, were not declared forests; now, I hear, they are to be finally thrown out of forest,

There is no incontrovertible tenet in forest demarcation that no land fit for cultivation should be kept when a demand is made for it—but it must be fit in a permanent sense. There are thousands of acres of land under grass, *kurans* or otherwise, in the Deccan, which are fit for cultivation—but for grass cultivation only, *i.e.*, to be used for grazing and grass cutting to the villagers. These, wisely, have been left out of forests or have been taken out of forests. But are they wisely used? There is, generally speaking, no control and these areas have rapidly deteriorated to land eroded almost to the rock, growing the poorest of grasses, *Aristidas*, spear grasses and others of a very innutritious kind. The indiscriminate grazing of goats has effectively prevented the growth of any shrubs or trees so that there is no shade for miles. The streams have eroded to sandy *nallas*, whilst the soil is a thin veneer of rubbly *murram*. There is nothing to prevent the immediate run-off of rain water so that a few hours after rainfall few traces of it remain. The *nallas*, too, soon run dry. The *maidans* round Poona, Nasik or Belgaum will suffice as examples—as also those in the neighbourhood of any considerable village in the Deccan.

That the land will recover is amply proved by the experiment of the Forest Department at Bhambhurda—but that was to be given up to sheep breeding, and a valuable lesson lost.

Wherein lies a solution to the problem of erosion, inadequate grazing, and the production of a poor race of cattle? And for the provision of firewood, to save the valuable manure for the fields? It is a national problem and needs to be tackled as such.

Two important basic things must be done:

1. To demarcate steep slopes and dedicate them to tree growth: not necessarily to invoke the Forest Department, for, if necessary, they may be made a charge of the village panchayats; but that charge must be effective to prevent goat and cattle damage, and looting by villagers. By this means the water "run-off" will be slowed down, and the water subsoil level raised.
2. To demarcate the remaining "waste" (the name is a good one, but there should be no "waste" in any civilised country) and dedicate it to *controlled* grazing: it should carry no more cattle than its capacity to feed. It is

> better to have fewer adequately fed cattle than the herds of poor beasts now roaming in their countless numbers in search of food which does not exist. Grazing should be paid for and the funds go towards village improvement in general, after the expenses of grazing control are paid. This would go far to the extinction of the thousands of miserable cattle now kept, for no one would be willing to pay for the upkeep of a useless beast.

To anyone who has seen the *maidans* grazed down to the soil throughout the year in most villages, the thought will occur as to how the desirable grasses have a chance to survive by seeding. In fact, they hardly do; so that if a grass is a good fodder its seeding is a miraculous event. Perennial coarse grasses survive by grace of their root-stocks, the rapid production of their fruiting culms, and inedibility of their own protected seeds; how soon the desirable grasses can hold their own if protected against excessive grazing could be seen at Bhambhurda.

"Controlled grazing" should, therefore, consist in (1) restriction of numbers to the limit of grazing "possibility;" (2) rotational grazing, to provide rest for a portion of the area to allow seeding of good fodder grasses—the need of their artificial production is not a strict necessity, but such would be a help; (3) to set apart areas for grass cutting to tide over the long dry season and (4) The effective control of goat grazing by its greater restriction (it is the most destructive animal in the world, large parts of which it has made destitute) wherever any attempt is made to produce shade trees, and its exclusion altogether from hill slopes.

In the past it was impossible to introduce any such beneficent schemes, owing to the opposition of the people (bred of ignorance, selfishness, lack of foresight and suspicion), to any curtailment of their rights, even for their own good. But it might be possible now, under a popularly elected Government, whose motives could not be suspected to be other than for the benefit of the community as a whole.

By the above means, the frightful waste by erosion on the Deccan hills and waste lands can be allayed and the benefit to the villagers will be untold. Erosion from dry-crop fields is also a problem, but that lies immediately in the hands of the cultivator himself, and is a concern also of the Agricultural Department. In the book above quoted, mainly devoted to erosion from crop fields, it can be seen how seriously this problem is considered in America and how expensive the measures taken.

BLEEDING FROM CREOSOTED SLEEPERS TREATED BY THE RUEPING PROCESS

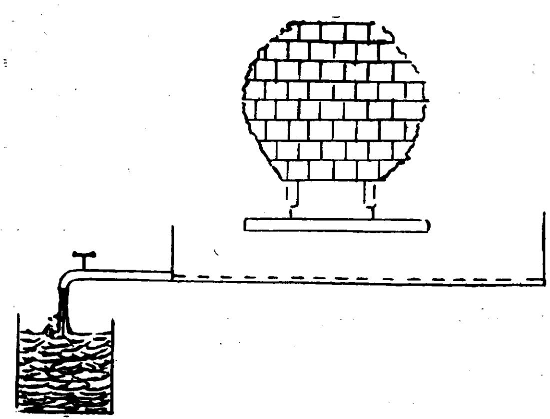
By A. D. Dhall, Sleeper Control Officer, Northern Group, Sleeper Pool.

The whole of the Dhilwan Creosoting Depot is soaked with creosote and oil. In the despatching yard the creosote and oil can nearly always be seen standing in little pools wherever there is a depression. Even the subsoil water in the depot and for some distance round it is said to be contaminated and smelling of creosote. This indicated that a considerable loss of creosote and oil is going on during the process of creosoting.

In the beginning of 1938 experiments were undertaken by me to find the sources of this loss with a view to preventing it if possible.

It was suspected that the biggest source of loss was through bleeding from creosoted sleepers after they come out of the creosoting cylinder. The following method was adopted to ascertain the amount of this loss.

A trolly load of creosoted sleepers as it came out of the creosoting cylinder was made to stand on a shallow trough made out of sheet iron, so that all the drip from the sleeper dropped into it. The trough was slightly tilted towards one corner where a one-inch pipe was fitted into it, to drain the collected creosote and oil into a measuring drum. The diagram below explains the contrivance used.



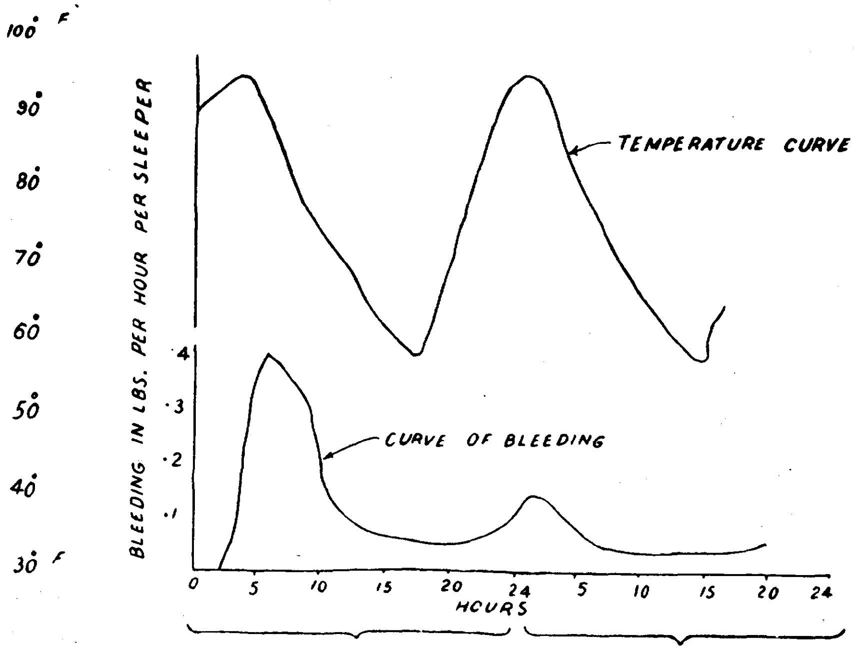
Loads of fir, deodar and chir sleepers were taken successively and amounts of creosote and oil that dripped out in each 24 hours were measured until there was no more drip. The results were very surprising and showed the very large amount of creosote and oil that is being wasted at present through bleeding. The average of a large number of experiments carried over nearly 12 months is tabulated below:

Species of wood	*Amount of bleeding as percentage of the amount originally injected*				
	First 24 hours	Second 24 hours	Third 24 hours	Fourth 24 hours	Fifth 24 hours
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Deodar	28	4	2	1	0·5
Fir	20	3·5	0·7	0·7	..
Chir	4	..	..	..	..

In summer the amount of bleeding was very much greater than in winter. As much as 45 per cent. in the case of deodar, 35 per cent. in the case of fir and 6 per cent. in the case of chir was noticed in the hot months of May and June, and as little as 25 per cent., 15 per cent. and 1 per cent. respectively in the coldest months of the year, *i.e.*, December and January.

An attempt was made to establish some relationship between atmospheric temperature and the rate of bleeding. With this view hourly readings were taken from a thermometer fixed near the bleeding trolly and the quantity of creosote and oil that dripped out was also measured every hour. Graphs were plotted but beyond showing that bleeding increased with the temperature, no definite rela-

tionship could be established. A typical temperature and bleeding graph was as below:



1st Day 2nd Day

To ascertain whether the creosote and oil were absorbed by the wood to different extents and whether the bleeding contained the two constituents of the preserving mixture in different proportions, samples of bleeding were sent to the Metallurgist for chemical analysis. This showed that the bleeding contained the creosote and oil in approximately the same proportions as in the preserving mixture and that no chemical change took place while the creosote and oil was inside the wood.

To understand the cause of bleeding it is necessary to know the process of treatment in use at Dhilwan. This process is known as Rueping and consists of the following:

1. After the sleeper trollies have been introduced into the treating cylinder, air pressures of 45, 55 and 75 lbs. per square inch are applied and are maintained for periods of 15, 20 and 30 minutes in the case of fir, chir and deodar respectively.

2. The cylinder is filled with a mixture of creosote and oil in the proportion of 40: 60 by weight without destroying air pressure.
3. Oil pressure is raised to about 180 lbs. per square inch and maintained for half an hour.
4. Oil pressure is broken and cylinder drained of oil.
5. A vacuum of 24 inches is created and maintained for periods of 30, 20, and 40 minutes in the case of fir, chir and deodar respectively.

Sleepers are then taken out of the treating cylinder and sent to the despatching yard.

Deodar sleepers receive an average of 10 lbs. per sleeper and fir and chir 15 lbs.

An explanation of the excessive bleeding in the case of the Rueping process, as I have deduced from the various trials, is as follows:

When the final vacuum is applied, a lot of the free oil is drained out and quite a lot of the air under pressure which was imprisoned in the sleeper when oil pressure was raised, is released. But on account of the viscosity of the oil, a certain amount still remains blocked up inside the capillaries of the wood. Sleepers, as they come out of the cylinder, are quite dry but as this air gradually finds its way out, it pushes out such oil as is blocking its passage in front of it and bleeding starts. When the atmospheric temperature is high, this passing out of the air is helped as heat causes the air to expand and reduces the viscosity of the oil. But when the temperature falls, not only does the oil get more viscid but the low atmospheric temperature also does not give the imprisoned air much help.

The experiments have proved that in the case of deodar and fir sleepers treated by the Rueping process considerable losses are incurred through bleeding. The annual loss to the North Western Railway for all the sleepers treated in the Dhilwan Depot has been estimated at about Rs. 25,000. All this goes to waste as the bleeding takes place before the sleepers leave the depot.

The question arises whether this loss can be stopped.

Trials are in hand to see if, by any variation of the treating process, bleeding can be stopped or minimised, so that the preserving mixture stays inside the wood and helps in prolonging its life. If no success is achieved by these, a scheme will have to be got out to collect this bleeding for re-use.

There is another question that these trials have raised. Certain quantities of creosote and oil were considered sufficient for preserving sleepers when the Rueping process was adopted. It is now found that nothing like these quantities are present in the sleepers when they leave the depot. Are the sleepers receiving enough of the preserving mixture and are we getting the best out of the wood? Only time and further investigation will provide the answer to these questions.

NOTE BY THE UTILISATION OFFICER,

Forest Research Institute

"Bleeding" of creosoted wood has always been recognised as one of the disadvantages of creosote treatment and, during recent years, considerable attention has been paid to this question in America. The "Committee on Bleeding" of the American Wood Preservers' Association defines the scope of its work as "the study of the cause and prevention of bleeding which is present not less than 48 hours after treatment." As the sweating which Mr. Dhall records takes place mostly within the first 24 hours, it may perhaps be better to consider it under what is known as "drip."

The various factors which are generally considered to be related to "bleeding" and "drip" are:

(1) The treatment process employed,

(2) The nature of the preservative used and the absorptions obtained,

(3) The nature of the timber used (species, structure, moisture content, quantity of summerwood, etc.), and

(4) Meteorological factors, etc.

Taking the first factor into consideration it is known that the "kickback" and "drip" are least with the full-cell process and greatest with the Rueping (empty-cell) process. According to Teesdale

and Weiss of the Forest Products Laboratory, Madison, a preliminary vacuum (full-cell process) reduces "drip" to a minimum but, at the same time, it tends to produce very uneven penetration and absorption, if only small amounts of preservative are forced into wood, and hence should not be used in such cases. This will be all the more pronounced with material containing a mixture of sapwood and heartwood. Preliminary air pressures (Rueping process) were found to increase the "kickback" as well as "drip," but the amount of "drip" was found to vary with different treating conditions of the same process. Teesdale as a result of his experiments with pine paving blocks came to the conclusion that it would be best to treat paving blocks in the green condition and that blocks which had been air seasoned should be steamed. He also concluded that while a preliminary and final vacuum (full-cell process) greatly reduces "bleeding," a preliminary vacuum tends to make the absorption of oil too rapid during treatment, resulting in uneven penetration. He also noticed that "bleeding" (*i.e.,* after the first 48 hours) was materially increased with increased absorption.

According to Thomson of the Sudan, if the preliminary vacuum did not serve any other purpose, it certainly reduced "drip" by 50 per cent. as compared with pieces treated without a preliminary vacuum. On the other hand, other American investigations have led the "Committee on Bleeding" of the American Wood Preservers' Association to conclude that poles treated by the empty-cell (preliminary air pressure) process "bleed" less (*i.e.* after the first 48 hours) than those treated by the full-cell process. The same view is held by some English and German authorities. This is in opposition to the conclusions come to by Teesdale and Weiss as a result of their work with paving blocks and small wood pieces and indicates the complexity of the problem.

In the case of Mr. Dhall's experiments, the problem seems to be a question of removal of trapped air, and very probably by a suitable choice of treating conditions and, if necessary, an expansion bath (see footnote), longer vacuum or final air pressure treatment, the trouble could be minimised. Until more experimental work is done, it is, however, difficult to come to definite conclusions. All that can be said is that the present treating schedule is probably not

suitable. The evidence, however, is not sufficient to condemn the Rueping system for Dhilwan conditions until various treating schedules have been tried out with this system.

A further factor which it is necessary to take into account is the very inadequate incision obtained in the case of fir and deodar by the Dhilwan incising machine. In the case of fir, penetration of creosote is practically entirely limited to the depth of the incision. This results in very shallow penetration and heavy absorption in the surface layers of the wood, and will certainly cause "bleeding." With better incising and consequently improved penetration, the trouble may be minimised.

The effect of temperature on bleeding is well known. A similar effect is probable with changes in barometric pressure.

Mr. Dhall is to be congratulated on his investigation which has brought to light the great importance of "bleeding" and "drip" in the case of coniferous sleepers undergoing treatment at Dhilwan. The solution of the trouble is, however, by no means simple, as though a change-over to the full-cell process may reduce "drip" to a minimum, it is by no means certain that this will give regular and even penetration at moderate cost. In this connection a considerable amount of further experimental work under Indian conditions is required, and it is the intention of the Wood Preservation Section of the Forest Research Institute to proceed with this investigation in collaboration with the North Western Railway. It is hoped that experimental work carried out simultaneously at the North Western Railway treating plant at Dhilwan and at the Forest Research Institute will result in an early and satisfactory solution of the present difficulties.

At the end of the pressure period after release of pressure with the timber still submerged, the oil temperature is raised by a further 10—20 degrees Fahrenheit. A vacuum is also sometimes applied at this stage. Both these aid in removing the air and surplus preservative.

TIMBER PRICE LIST, APRIL-MAY 1939

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 33-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 0-15-7 to 1-3-3 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-2-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-12-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-9-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-12-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Rs. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-3-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Rs. 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Rs. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-14-0 to 1-8-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-0 to 2-5-0 per c.ft.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 0-8-6 to 1-4-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Rs. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-4-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 0-10-0 to 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	Rs. 2-6-9 to 6-1-3 per c.ft. in round.
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 31-4-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-6-0 to 1-5-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 1-0-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-8-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Rs. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Rs. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Rs. 1-0-0 per scantling.
,, ..	,, ..	Madras ..	Logs ..	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs ..	Rs. 0-12-10 to 1-6-0 per c.ft. in round.
,, ..	,, ..	U. P. ..	Logs ..	Rs. 0-12-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Rs. 0-12-0 to 1-15-8 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-10-6 to 2-12-6 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-8-0 to 2-10-0 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs ..	

EXTRACTS

NATIONAL PLANNING FOR CO-ORDINATED DEVELOPMENT OF RESOURCES IN THE U. S. A.

Most people are familiar with the great Tennessee Valley enterprise, which exemplifies public effort in conservation of natural resources for the improvement of the economic and social life of a particular area and is centred round the control and use of the great river. A very interesting paper, by the Dean of the Yale Forest School, H. S. Graves, is published in the *Forestry News Digest* for January 1939, in which he gives a brief but most instructive account of what this project aims to accomplish, though he mentions that the

basic conception has been somewhat obscured by a controversy about competition between power produced at the new federal reservoirs and that from existing private concerns.

"The Tennessee Basin forms a crescent extending from the high Appalachian Mountains, including in its central portion a rich agricultural region occupied by farms, and prosperous industrial cities and towns, and in the western portion merging with the lands characteristic of the Mississippi delta. The valley comprises 40,600 square miles of land, diversified in topography and climate and with peoples representing three or possibly four rather distinct cultures.

For a hundred years there have been federal expenditures to improve navigation, but never adequate. During the years the damage by floods has increased, as a result of land abuse. In the mountains the forests have been exploited without building permanent industry to support the people. A stranded population remains in many portions with the best of the original resources greatly depleted. On the basis of the present use of resources some counties have reached a maximum population and there is no room for the children as they grow up. They must migrate or remain in abject poverty.

The Tennessee Valley experiment is directed to complete regulation of the river by a series of storage, flood control and navigation works. Hydro-electric energy is to be developed, to provide cheap power for industry, farm and domestic use. The existing federal and state forests are to be extended, and effort is made through co-operation to conserve the large aggregate of private forests. Extensive work is carried on in control of soil erosion that is serious in many places. In the farm regions liberal funds are allotted to encourage farm co-operatives. Federal leadership is exercised to bring into the regions wood-working plants and other enterprises to make a local market for products of forests, farms and mines. Highways are constructed to enable factory workers to occupy their old homes and work at the factories.

These and many other activities are conducted in accordance with a comprehensive plan, all directed to co-ordinated use and development of the local resources under principles of conservation."

The Dean points out that National planning in the use and development of national resources was initiated by Theodore Roosevelt and that though great progress in many lines of endeavour was achieved under the succeeding Presidents, it is Franklin Roosevelt who made national planning in the internal development of the country a major policy of his administration. This policy has been put into effect by the formation of the National Resources Board, working in conjunction with various regional and State planning boards and supported by the Federal and State agencies dealing with various internal resources. Until recently little had been done in flood control on the upper portions of the watersheds throughout the country, although extensive works had been carried out in the lower portions of the Mississippi, the Ohio, the Joaquin, the Sacramento and to a limited extent in some other rivers. It was the great Mississippi flood of 1927, resulting in a loss of over 200 lives and damage to property of over two hundred million dollars which was largely responsible for a change in policy. The following extracts are as fully applicable to Indian conditions as to those of America. It is to be hoped that their teaching may be applied before some similar disaster focusses public attention on the need for their consideration.

"In systematic planning in any undertaking the first step is to define the problems involved. In conservation there is required as a basis a survey of the natural resources to determine their character, extent and possibilities for maximum service in support of local communities and consumers of products elsewhere. Usually there appear many obstacles in the way of better utilisation of resources in a given region, such as wide distribution of land ownership, diversity of purpose of individual owners, lack of foresight and incapacity for technical handling of land, need of highways or other public improvements, lack of adequate water supplies, exposure to flood or drought, unhealthful environment, lack of capital and many other factors.

Usually it is readily apparent that little progress can be made in conservation and development of the resources in a region without public works or direct federal or state aid to the communities, or to individuals, or both. In fact, it may be stated as a cardinal principle that co-ordinated land use, that is, conservation of

natural resources, requires extensive participation by the public in practically every region of the country. We may look to increased public controls of one sort or another of the use of the resources, not alone to insure benefits to the public but to enable industries to meet their varied problems in developing natural resources.

I may illustrate this feature by reference to the control, conservation and use of waters. One of the most urgent problems in the country is the control of the flow of streams and rivers. I do not need to describe the economic loss and the retardation of industrial progress caused by recurrent floods and irregular dry weather flow in our rivers. This is a problem beyond the power of individuals to solve.

The present conception is that planning for river development should include not only works for flood control, but also reservoirs for storage to supply water for domestic use, for factories situated on the streams, for maintaining maximum summer flows to dilute impurities, for hydro-electric power, for irrigation and waters needed in other phases of agriculture, for protection of fisheries, for conservation of migratory water fowl, and for recreation. Still more, it is now recognised even by engineers that stable conditions of water flows require also proper handling of the land tributary to the streams. The presence of well handled forests on the slopes has a great influence in the control of soil erosion, in retardation of surface run-off of water and in increasing the amount of underground seepage of water that contributes to maintain the summer flow of streams.

In working out a regional plan the public contributes the chief cost of river improvements, building of highways, erection of sewage disposal plants, and works for distribution of water to consumers. The public is establishing an extensive system of forest reservations and parks, expending funds for protection of forests from fire, insects and fungus pests, in education of owners in better practices of forestry, and now even providing benefit payments for stand improvement in farm woodlands in tree planting.

Large federal funds are being expended in control of soil erosion on all classes of land. Under the various agricultural laws farmers are aided in crop production, animal husbandry and various

other activities that will aid in stabilising their undertakings. The Government and States are establishing wild life refuges and otherwise endeavouring to conserve and make of service wild animals, birds and the inland fish.

Here is a conception of co-ordination of use and development of resources that, while not new, has only recently been brought into definite planning through federal leadership. The central feature is planning for stream regulation and development. Co-ordinate are the conservation of forests, measures for soil erosion control on crop land, proper handling of range and pasture, regulation of discharge of sewage from cities and chemical waste from factories and mines that are now polluting the streams and co-ordination of measures of conservation of wild life and recreation with that of land resources."

It is interesting to note that it was an extensive study of the possibilities of engineering works on all the rivers of the United States, carried out by the Corps of Army Engineers, which formed the basis for the broader national and regional planning now under way in the United States.

E. A. G.

EUGENIA JAMBOLANA

The following appeared in the March 1939 number of *Current Science* (Vol. 8, No. 3) under Letters to the Editor:

Eugenia jambolana.—The bark, the seeds and the fruit pericarp of this plant have some reputation as cures for diabetes, chronic diarrhœa and dysentery and as a gargle for sore-throat. Though a certain amount of work has been done regarding the chemical composition of the seeds, rather conflicting reports have been made. The earlier workers reported the presence of a glucoside (Börsch), quercitol and cinnamic acid (Pottiez)[3] and that an extract of the kernels prevented diastatic hydrolysis of starch (Stephenson).[5] Later workers (Power and Callan,[4] Hart and Heyl[2]) were of the opinion that the seeds contained no alkaloid, glucoside or enzyme. Further, some of the samples that were examined do not seem to have been preserved in good condition. The results of our exam-

ination of a fresh sample of the seeds obtained locally agree with those of Hart and Heyl except in regard to the presence of free sulphur which we could not detect. Ellagic and gallic acids together with tannins are probably responsible for the medicinal value of the seeds. We have also obtained small quantities of a sweet smelling yellowish-green oil and a colourless crystalline solid which has the properties of a wax. It melts at 81—83 degrees and the unsaponifiable part of it has been identified as myrical alcohol.

The fleshy pericarp of the fruits has not been examined before. It is now found that the sweetness of this material is entirely due to the presence of reducing sugars and that there is a total absence of sucrose. The sourness and astringency seem to be due to the presence of gallic acid and tannin. A fairly high percentage (0.6 per cent. of the weight of the dried pericarp) of ammonium chloride could be isolated. The beautiful purple colour is partly due to the occurrence of an anthocyanin, which has been identified as cyanin. During our attempts to isolate this pigment, it was realised that a considerable portion of the colour is due to the presence of a second pigment, which is phenolic in nature and crystallises from dilute alcohol as snuff-coloured plates melting above 300 degrees Centigrade.

Two colourless crystalline compounds have also been isolated from the pericarp, one melting at 149 degrees Centigrade and the other at 232 degrees Centigrade. The first is easily soluble in alcohol and gives a bluish-violet fluorescence when dissolved either in aqueous sodium carbonate or sodium hydroxide or in concentrated sulphuric acid. It seems to belong to the group of hydroxybenzopyrones. The second is far less soluble in alcohol and gives a pale green fluorescence in concentrated sulphuric acid. Detailed reports about these compounds will soon be published.

N. V. SUBBA RAO,
T. R. SESHADRI,
Department of Chemical Technology,
Andhra University, Waltair.

February 22, 1939.

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3. Pottiez, *Ann. Pharm. Louvian*, 1899, 5, 373, 490.
4. Power and Callan, *Pharm.* J., 1912, 34, 414; 1913, 91, 245; J.C.S., Abst., 1912, ii, 480; 1913, i, 1057.
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DOMESTIC OCCURRENCES

Marriage.—Garland-Leighton-Stevens. On 20th May 1939, at Christ Church, Mussoorie, Edward Andrew Garland, youngest son of the late Colonel E. A. C. Garland, D.S.O., and Mrs. Garland, to Dorothy Shelagh, youngest daughter of Mr. and Mrs. Leighton-Stevens of Windy Corner, Hayling Island.

Death.—Grieve. On 10th April 1939, James Wyndham Alleyne Grieve of Beechwood, Beech, Hants, late Indian Forest Service, after a short illness, aged 67.

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons)					
	MONTH OF MARCH			12 MONTHS 1ST APRIL TO 31st MARCH		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
Siam ..	30	5	..	974	1,110	806
French Indo-China	449	262	167	3,149	2,258	3,677
Burma ..	..	17,063	12,496	..	1,61,110	1,52,013
Java ..	180	245	455	1,860	4,923	3.318
Other countries ..	23	..	..	24	637	81
Total ..	682	17,575	13,118	6,007	1,70,038	1,59,895
Other than Teak—						
Softwoods ..	1,528	1,476	921	14,493	19,661	15,468
Matchwoods ..	807	260	1,066	11,442	9,342	8,967
Unspecified (value)	..	..	..	..	..	..
Firewood ..	40	27	25	365	624	656
Sandalwood ..	57	..	..	309	142	146
Total ..	2,432	1,763	2,012	26,609	29,769	25,237
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	36	76	..	698	475
Plywood ..	362	500	392	3,469	5,248	5,976
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	362	536	468	3,469	5,946	6,451
Total value of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	19,292	37,321	26,466	2,21,225	2,20,843	2,86,728

Seaborne Trade and Navigation of British India for March 1939 :

IMPORTS

ARTICLES	VALUE (Rupees)					
	MONTH OF MARCH			12 MONTHS, 1ST APRIL TO 31st MARCH		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
Siam ..	4,659	592	..	1,20,371	1,41,853	1,06,489
French Indo-China	47,270	34,677	19,699	3,25,543	2,71,598	4,41,653
Burma ..	..	21,05,170	16,16,556	..	2,06,44,496	1,99,53,696
Java ..	18,456	31,872	43,242	2,00,724	6,29,531	3,37,925
Other countries ..	4,118	..	..	4,211	71,218	9,402
Total ..	74,503	21,72, 311	16,79,497	6,50,849	2,17,58,696	2,08,49,165
Other than Teak—						
Softwoods ..	1,00,234	1,20,983	58,176	8,75,039	14,97,496	10,84,285
Matchwoods ..	45,111	15,475	71,169	6,40,831	5,70,372	5,86,168
Unspecified (value)	16,201	1,77,987	2,99,507	3,38,057	28,30,618	31,75,166
Firewood ..	600	405	345	5,463	9,366	8,249
Sandalwood ..	12,503	..	271	97,447	38,678	37,780
Total ..	1,74,649	3,14,850	4,29,468	19,56,837	49,46,530	48,91,648
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	2,614	9,434	..	84,207	64,847
Plywood ..	81,557	1,18,352	82,386	7,70,423	11,56,498	12,44,783
Other manufactures of wood (value) ..	1,66,738	1,81,467	1,36,501	15,23,444	18,80,545	16,18,548
Total ..	2,48,295	3,02,433	2,28,321	22,93,867	31,21,250	29,28,178
Total value of Wood and Timber ..	4,97,447	27,89,594	23,37,286	49,01,553	2,98,26,476	2,86,68,991
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	1,33,818	3,43,809	2,54,092	14,64,397	18,35,406	27,39,495

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF MARCH			12 MONTHS, 1ST APRIL TO 1ST MARCH		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	5,028	..	6	45,789	229	53
,, Germany ..	1,162	..	..	5,695	..	1
,, Iraq ..	64	44	32	769	282	252
,, Ceylon ..	254	..	..	1,682	4	2
,, Union of South Africa ..	282	4	..	6,383	4	..
,, Portuguese East Africa ..	174	..	..	2,141	..	..
,, United States of America ..	38	..	..	470	..	..
,, Other countries	668	351	177	6,553	1,278	2,073
Total ..	7,670	399	215	69,482	1,797	2,381
Teak keys (tons) ..	536	..	..	4,080	..	..
Hardwoods other than teak ..	363	..	..	1,860	15	2
Unspecified (value)	..	..	..	..	..	..
Firewood ..	..	5	..	7	172	..
Total ..	899	5	..	5,947	187	2
Sandalwood—						
To United Kingdom	11	..	..	19	22	23
,, Japan ..	5	1	1	85	66	46
,, United States of America ..	84	..	14	539	588	358
,, Other countries	14	14	34	202	326	220
Total ..	114	15	49	845	1,002	647
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	..	..	..	..	..	..
Total value of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber	No data			No data		

EXPORTS

ARTICLES	VALUE (RUPEES)					
	MONTH OF MARCH			12 MONTHS, 1ST APRIL TO 1ST MARCH		
	1937	1938	1939	1936-37	1937-38	1938-39
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	11,13,792	..	498	95,88,315	30,947	6,467
,, Germany ..	3,17,880	..	..	14,00,554	..	150
,, Iraq ..	11,261	4,198	2,723	1,34,967	46,667	65,592
,, Ceylon ..	41,942	..	..	2,44,258	266	343
,, Union of South						
Africa ..	63,630	447	..	13,13,894	447	..
,, Portuguese East						
Africa ..	33,125	..	..	3,71,275	..	..
,, United States of						
America ..	9,515	..	..	1,35,527	..	..
,, Other countries	1,40,296	57,496	38,602	14,06,264	2,89,452	7,20,059
Total ..	17,31,441	62,141	41,823	1,45,95,054	3,67,779	7,92,611
Teak keys (tons) ..	92,985	..	..	5,92,862	..	..
Hardwoods other than						
teak ..	36,341	..	125	1,89,272	4,020	547
Unspecified (value)	3,84,203	1,27,857	95,078	12,14,900	12,50,547	3,99,119
Firewood ..	..	50	..	111	1,785	..
Total (value) ..	5,13,529	1,27,907	95,203	19,97,145	12,56,352	3,99,666
Sandalwood—						
To United Kingdom	11,600	..	1,425	19,900	24,030	26,580
,, Japan ..	2,766	880	..	1,41,524	65,560	48,958
,, United States of						
America ..	87,400	..	16,000	5,81,948	5,95,715	3,70,380
,, Other countries	17,075	11,462	32,102	2,43,586	3,23,562	2,07,825
Total ..	1,18,841	12,342	49,527	9,86,958	10,08,867	6,53,743
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	28,886	32,674	31,497	1,67,662	3,16,721	5,20,398
Total value of Wood and Timber ..	23,92,697	2,35,064	2,18,050	1,77,46,819	29,49,719	23,66,418
Other Products of Wood and Timber	No data			No data		

INDIAN FORESTER

JULY 1939

THE LAND AND THE STATE

Scientific as well as political opinion in Britain seems to be veering steadily in favour of State ownership of the land. Views differ, however, as to the extent to which the State, having acquired the ownership, should also make itself responsible for the actual management of the land. The one point upon which opinion seems to be unanimous is the necessity for planning, for a term of years in advance, at least the broad principles upon which the management should be conducted.

It is somewhat remarkable how little attention has hitherto been given in India to the fact that the very extensive areas which have been legally settled as Reserved and Protected Forests constitute what is perhaps one of the largest estates in the world which is managed, as well as owned, by the State.

Excluding the unclassed State forests, of which there are about 21,000 square miles (mostly in Assam), there are in British India some 73,000 square miles of Reserved forests and 7,000 square miles of Protected forests. Of these Reserved and Protected forests approximately 80.9 per cent. of the total area is managed under plans which have been scrutinised and approved by the Governments concerned and printed and published for perusal by all those who may be interested. Most of these plans are also examined by the Inspector-General of Forests and by the experts at the Forest Research Institute at Dehra Dun before they are brought into force. In this way the sum of past experience in forest management throughout India and other parts of the world is available for incorporation in any new plan under preparation.

When the first plans were drawn up, about 1850, the forest estate was, in consequence of the lack of any form of organised management or of control over the local populace, generally in a deplorable condition, aptly typified by the title of "jungle" which was generally applied to it. The productive capacity of the soil was

largely going to waste. The vegetation which it produced was generally poor either in quality or quantity, or in both; frequently ravaged by fires; sometimes laid waste by primitive methods of shifting cultivation which yielded crops of grain of small value at a sacrifice of large quantities of stored fertility. The earliest plans consequently consisted of little except rough schemes for the gradual introduction of order out of chaos and for the exploitation of the existing stocks of mature, or overmature timber, in such a way that the yields should in future be regular instead of spasmodic, that increase should replace depletion and that the productivity of the soil should be put to greater advantage.

During subsequent years, gradually accumulating knowledge of better methods of working, as well as increasing realisation of the very large number of factors which must be given careful consideration if satisfactory methods of management are to be evolved, resulted in greater elaboration in the prescriptions embodied in the plans. In addition to the scientific exploitation of the timber crops, up to which all these prescriptions lead, the most recent plans comprise, in considerable detail, an ecological survey of the whole locality. The value of such surveys is very great for a number of purposes quite apart from forestry, indicating as they do the basis upon which each locality can be developed for the greatest benefit of the local inhabitants and of the whole community.

Much confusion of thought and even complete misunderstanding exists in the popular mind in India regarding the objects for which these State-owned estates were formed. The sole reason for the legal creation of Reserved and Protected forests was that purely local advantages of user should be brought under such measure of control that the estates so formed should be capable of being managed to the best advantage of the people as a whole. The existence of these estates, therefore, typifies in a very concrete manner the fundamental principle which underlies the responsibilities as well as the rights of all citizenship in any State. For, as Lord Hailey recently pointed out* "the State is a fellowship of men aiming at the enrichment of the common life and cannot be judged only by the routine action of its machinery. It must not merely secure the

* Lord Hailey's Sir G. B. Birdwood Memorial Lecture before the Royal Society of Arts, 24th February 1939.

acquiescence of the common man but must be responsive to the ideals of its best and most formative elements. But, even so, the factor of general acquiescence must always be one of the most important elements of its success." The legal distinction between Reserved and Protected forests provided flexibility in regulating such local uses of these lands as would conflict with methods of management designed to produce the maximum benefits for the State, which means for the citizens of the State, as a whole. The difference in status between Reserved and Protected forests is, briefly, that in Reserved forests everything is illegal which is not specifically permitted, whereas in Protected forests nothing is illegal which is not expressly prohibited. The principal object of management in all cases is, consistent with the permanent welfare of the people, to produce the maximum revenue and at the same time to provide a reasonable standard of living for the largest number of citizens.

Climate and topography are ruling factors, *to which careful* consideration must be given in deciding the degree in which the other great factor, human interference with the natural vegetation, can most appropriately be organised in the plans for future management. Speaking in broad terms, modifications of the natural vegetation by men result in putting it to uses which fall into three classes: *land under arable cultivation, land used as pasture and land devoted to forest.* In addition, there is, of course, the land set aside for men's habitations; for factories, for shops and for housing themselves, their families, their implements and their domestic animals. Proper provision for tree crops in forests and for grass crops as pasture is essential for a balanced economic structure. How this provision can best be made depends upon the general rural organisation and in particular upon whether most of the land is in the possession of large landowners or of small peasant proprietors. The smaller the individual holdings the fewer are the domestic animals belonging to each individual cultivator and the more he tends to concentrate on owning only arable land. Pasturing one or two animals by themselves is definitely uneconomic and consequently the cattle under these circumstances are either stall-fed, or sent out to graze as a combined herd from each village.

The Government of India was careful to recognise the need for pastures for the village herds at the time Reserved forests were being

created and was equally insistent that such pastures should be given proper treatment. In a Resolution in 1891 this policy was clearly stated: "It is in the opinion of the Government of India advisable for convenience of administration that all lands set apart for special treatment as pastures, fodder reserves or forest proper should, so far as the law permits, be placed under the forest law as 'Reserved Forests,' but it should be understood that it is not necessary that because an area is constituted reserved forest, it must be managed for the purpose of producing trees or placed under the control of the officers of the Forest Department. The method of treatment of such lands and the arrangements of their control must be regulated entirely by the local authorities with whom remains the power to determine the agency and system of management." Unfortunately, the views of the Government of India in this matter were in advance of popular opinion and of the local administrations. Consequently, most of what were formerly the most accessible grazing grounds remained "waste" in name and have now generally become waste in actual fact, utterly degraded by excessive, uncontrolled, grazing and consequent disastrous erosion. On the other hand, for those areas, handed over to the Forest Department for management, which were by nature similar to much of the waste land but by situation more remote from the villages, the working plans have provided steadily increasing detailed management of the grazing facilities. Particularly in recent years has the realisation of the absolute necessity for control of grazing been reflected in the provisions of the latest plans and in the writings of officers of the Forest Department. In last month's number an article* was published describing in general terms conditions prevalent in Bombay and the lines upon which they might be improved. In this number will be found more detailed proposals by an officer from the Central Provinces† and also the draft rules for the regulation of grazing which have recently been circulated by the Government of Bombay‡. A large measure of agreement will be observed in all these proposals.

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* "Soil Erosion and Grazing Problems in Bombay," by R. W. Inder.

† "Making Better Grazing Available in Open Pasture Forests," by K. P. Sagreiya.

‡ Draft Grazing Rules for the Province of Bombay.

FORESTRY BEYOND THE INDUS—III

By H. L. Wright, I.F.S.

III.—THE FORESTS OF SWAT KOHISTAN

Twenty years ago Swat was a turbulent tribal territory; to-day it is a peaceful, prosperous State. Here rule is largely personal, a network of telephone and roads enabling the Wali to keep in constant and direct touch with every fort and *tahsil* in the State. Few Indian States, whatever their size and traditions, are more efficiently governed than Swat, and evidence of this is found in the keen personal interest that the Ruler takes in the conservation and management of his forests.

The valley of the Swat river falls naturally into two distinct parts, the lowlands and the highlands. The former consists largely of broad, fertile, well-cultivated valley lands which rival both in beauty and in richness the more famous valley of Kashmir. The highlands, or "Kohistan" as they are called, take in the whole of the upper reaches of the Swat river, but not the whole of these lie within the Swat State, for the uppermost reaches of all, which are reputed to contain some wonderful deodar forests, are included in three little village republics, collectively known as "Kalam," which so far have steadily maintained their independence.

Although there are extensive forests of blue pine and chir in the lower parts of the State, it is only the Kohistan deodar forests that have been brought under management and are controlled by the Forest Department. Here, previous to the settled rule of the Wali, the villagers did much as they pleased, selling large numbers of trees to traders from British India, whenever they were hard up for money. At times as many as seven or eight traders would be working in different parts of the valley and, during the War, when prices of timber were abnormally high, enormous quantities of logs were exported to Nowshera to meet the needs of the Munitions Board. Work in these forests is said to have started as far back as 1860 and it continued intermittently until 1918, when pressure was brought by the Political Department to restrict further fellings.

Soon after Kohistan was brought under the Wali's control he expressed the wish to re-open the forests for working, but before

granting permission for export, Government insisted on an examination being made by a forest officer to determine from what areas and to what extent fellings could be made. The officer selected for this work was Khan Sahib Allayar Khan, an Indian Forest Service officer from the Punjab, who spent most of the hot weather of 1926 in Swat Kohistan.

At the time of his inspection the forests were found to fall roughly into four types:

(*i*) those far away from the main river which, being unworkable for logs, had escaped the attentions of the "get-rich-quick" traders. These forests were more or less virgin and contained pure overmature deodar with little or no regeneration and, as a result of past fires, many dead and dying trees;

(*ii*) those on precipitous ground, from which the deodar was slowly disappearing, the older trees showing obvious signs of deterioration and very little regeneration coming in to replace them;

(*iii*) those which had been worked to meet local needs but not for export. These were pure deodar forests of all ages, well stocked, with poles predominating and excellent regeneration, wherever a gap had been made in the canopy; and lastly

(*iv*) those immediately above the main river, from the lower portions of which every convertible tree had been removed.

Except in the last type, no permanent damage had been done and it is fortunate that in the days of unrestricted fellings no one thought of working these forests for sleepers, as destruction was thus limited to those areas from which logs could be removed without difficulty. In such accessible places, as in many other places in India and Kashmir, these early fellings, made before the days of conservation, put thousands of acres out of productivity and made it almost impossible for such areas ever again to carry a crop of deodar.

These Kohistan forests are practically pure deodar. Other species are found, such as blue pine, spruce, fir and oak, but they are of no importance. They have been described as dry zone deodar

Deodar forest on the border of Swat and Kalam.

Photo: H. L. Wright.
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Deodar forests in Swat Kohistan.

Photo: H. L. Wright.
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forests, but this they certainly are not; they are, in fact, very akin to the forests lying in the inner valleys of Kashmir which receive a scanty monsoon rainfall but a fairly heavy precipitation during winter and spring, a climatic condition that appears almost ideal for the growth of deodar.

Allayar Khan's main proposals were demarcation, survey and a simple forest settlement, while from an ocular estimate of the growing stock he recommended the removal of 2,000 first-class deodar trees per annum for the next fifteen years. These proposals were sent for review to Parnell, who, as mentioned in a previous article, was then on special duty in the province. He, therefore, spent two months in Kohistan in 1927 and was able to make a detailed examination of the forests and to arrive at definite conclusion regarding their future management. He strongly supported the proposals for demarcation, survey and settlement, but did not agree with the proposed silvicultural treatment. In his opinion the deciding factors in future management were, firstly, the great shortage of middle-aged trees and, secondly, the abnormally large regeneration area that had been created by the fellings of the previous fifteen years. The report, written by him at the end of his visit and the proposals made therein for future management, were accepted by the local Administration, who ordered the report to be treated as the preliminary working plan report.

Demarcation was carried out during 1928 by Allayar Khan when, with the consent of the Wali, all large compact blocks of forest in which there was a good crop of deodar and all over-exploited areas, away from the villages, suitable for restocking, were demarcated.

A forest settlement followed during the next year, the main points of which, as sanctioned by the Wali, being: all deodar was declared to be the property of the State, subject to the payment to the former owners of two rupees for every tree over 24 inches diameter felled for export; the burning of deodar forest was prohibited and the grazing of foreign animals was limited; deodar was allowed to be felled for local requirements with previous permission, but for felling any other species no permission was necessary.

Then followed the working plan, the field work being carried out by Allayar Khan during 1930. Work was started under the plan in 1931, although it was not finally sanctioned until four years later.

The plan covers a total area of 48,738 acres, which is divided into two working circles. The first, covering 32,840 acres, contains everything that is capable of being managed under a regular system of management, in this case the selection system, from which the working circle takes its name. The second takes in all the remaining deodar forests which, for one reason or another, cannot be worked. Here nothing but protection is attempted and the working circle is therefore called the protection working circle.

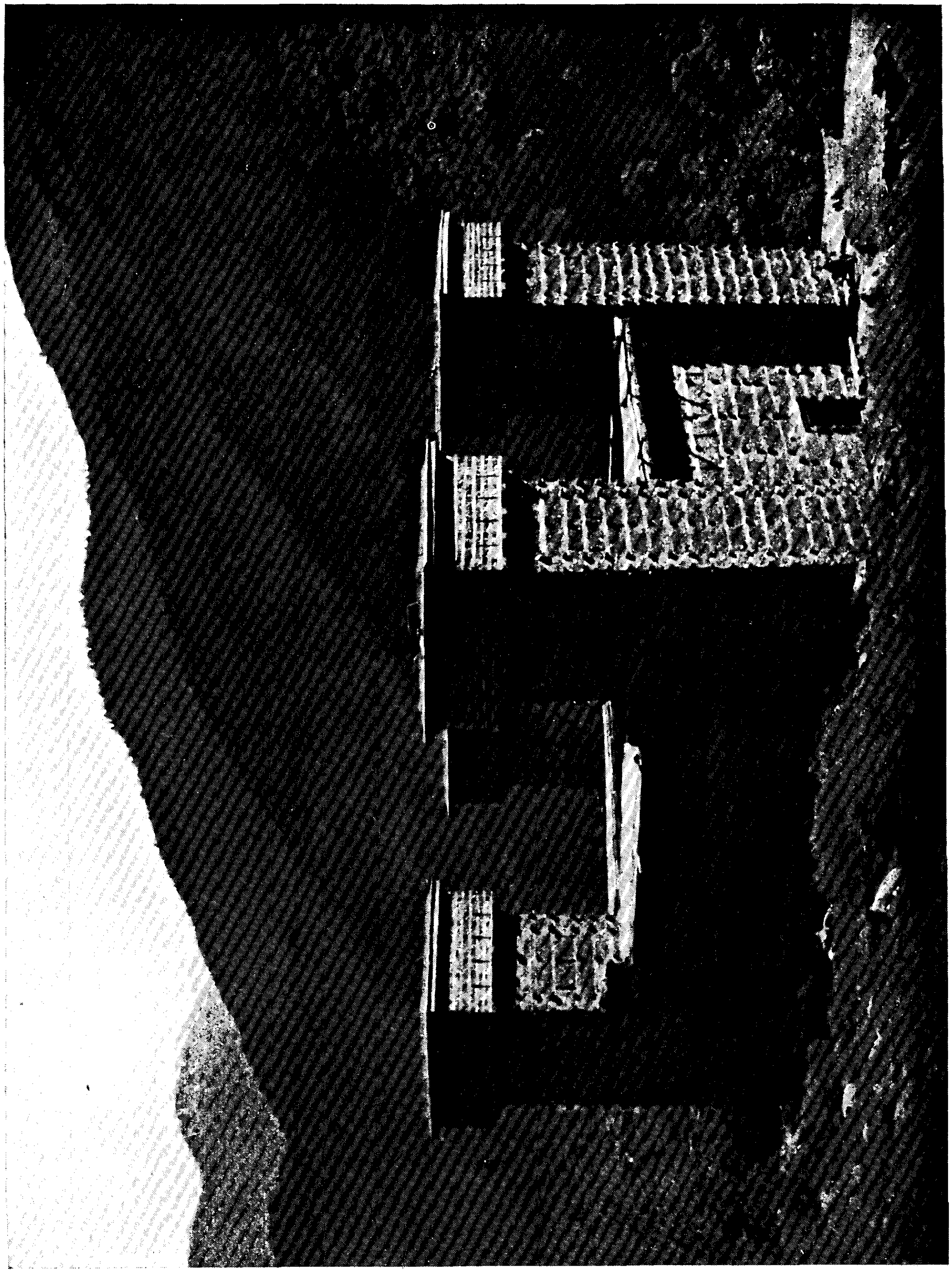
The selection working circle is divided into two felling series, called the export and the local. The former is worked mainly for export, though provision is made in each compartment to retain a reserve sufficient to meet local demands. Forests in the local felling series, on the other hand, are worked to meet the requirements of the State and of the local villagers, though provision is made for any surplus being utilised for export.

The yield was calculated separately for each felling series, although the formula used was the same in each case, *viz.*, two-thirds of the first-class plus one-third of the second-class trees divided by forty, the number of years it was estimated that a second-class tree (24-inch diameter) would take to become first-class (30-inch diameter). The prescription was expressed in terms of trees 24-inch in diameter and over, it being considered unsafe to allow uncontrolled fellings of second-class trees. The yield worked out at 1,200 trees per annum for the export felling series and 300 for the local felling series, the former comprising a main felling of 1,000 trees from a definite area for export and 200 trees from the whole series for State and local use.

The plan has worked well. Trees are marked by a gazetted officer of the Forest Department and there has been no difficulty in marking the prescribed yield. Sales are made by the State, the purchasers' work being supervised by the Forest Department. At one time there was difficulty in finding a purchaser but this is not likely to happen again. Forest work is well organised and practically the whole outturn is converted into sleepers in the forest floated by the Swat river to the State border and from there carried by motor lorries to railhead at Dargai. There is thus little risk of loss in transit, and as this becomes better known, higher prices are obtained for the standing trees, the prices under the present lease showing an

The end of Swat State; the border lies along the two near ridges; beyond these is the independent territory of Kalam.

Photo: H. L. Wright.
(Copyright.)



Pashmal Fort, showing the Haryani Deodar Forest in the background.

Photo: H. L. Wright.
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increase of about forty per cent. over those paid under the previous agreement.

So far, little has been done under the miscellaneous prescriptions of the plan, but as it is only a few years since this tract was brought under control, it is better to proceed slowly with measures of forest conservancy than to force the pace and so risk antagonising the local people. Moreover, till recently, trees have sold at a low price and there has not been much money available for improvements. But now that prices are better and the people are becoming more used to settled rule, it is hoped to put back some of the wealth that has been taken from the forests, at least to the extent of clearing up after the lumberman, for otherwise it will be difficult to obtain regeneration and difficult in that case to maintain the present yield when the working plan comes under revision.

THE MOST PAYING ROTATION IN INDIAN FORESTRY

By M. V. Laurie, Silviculturist, F. R. I.

Summary.—The classical "financial rotations," implying rotations producing the highest rate of interest on forest capital, are shown to be either meaningless or unsuitable in respect of practical forest finance in India, and it is argued that the rotation of maximum net income should be adopted regardless of the rate of interest this represents on forest capital. Such rotations are far longer than the classical financial rotation but produce a much higher net annual revenue from the forest, and as all net forest revenue is handed over to the state for administrative expenditure in the same way as revenue from taxes, the tax-payer is being best served by working the forests on the rotation of highest net income and not on the less productive "financial rotation."—*Author.*

A certain amount of discussion has taken place in the pages of the *Indian Forester* in the past on the subject of forest finance. These discussions were controversial and often erudite, covering large areas of paper with complex formulæ but, owing chiefly to the highly theoretical basis of the whole structure of the forest finance of the classical school as exemplified in Schlich's Manual of Forestry, Vol. III(1) and (from a more practical viewpoint) in Hiley's "Economics of Forestry" (2) and also on account of the almost complete neglect of the fundamentally different economic conditions under which forestry is carried on in India, very little practical guidance emerged from these discussions regarding the best rotations, from a financial point of view, on which to work the forests of India. Such influence as the teachings of classical forest finance have

had on the management of forests in this country appears to have been to a certain extent deleterious, leading to undesirably short rotations and reduced revenue. It is fortunate, perhaps, that the indications of these doctrines are so indeterminate and the formulæ for working out the financial rotations contain so many incalculable factors that Working Plan Officers have generally fought shy of them and have either prescribed rotations corresponding to something near the maximum mean annual volume increment (which is incidentally incorrect without also considering the potent effect of price increment), or they have adopted arbitrary rotations which would produce trees of a certain diameter. Such rotations, though admittedly somewhat of a makeshift, are probably better than the dangerously short rotations which are likely to result from the incorrect application of the classical concept of the "financial rotation."

Some old war horses will already have scented that I am about to raise the old, old controversy of the "Rotation of Maximum Net Income," versus the "Financial Rotation." This controversy was waged for a number of years in Germany after the war with, not infrequently, considerable bitterness, and the ultimate result was a qualified acceptance of the idea of the classical "Financial Rotation." Since then, however, compromises between the two have been sought in order to avoid the very short rotations and low money yields which a strict adherence to the "Financial Rotation" implied (3).

A similar discussion was conducted in the pages of the *Indian Forester* in 1922 (4 to 9). It was initiated by R. Bourne, who was the protagonist of the "Rotation of Maximum Net Income," and he roused a fierce controversy over the somewhat involved theories he put forward. The final result was a vague and somewhat qualified acceptance of the Rotation of Maximum Net Income.

It is with some trepidation that I open the subject again as I expect I shall raise such a storm of criticism from the worshippers of the mystic symbol $1.0p^n$ that I shall be well-nigh overwhelmed. I believe, however, that the previous discussions were conducted under several basic misconceptions and I am so convinced of the essentially practical importance of the matter as affecting our general forest policy that I think it is time that it should be thoroughly ventilated so that some authoritative conclusion can be reached.

Such discussion should be limited to Indian conditions from a strictly practical viewpoint.

In order to forestall possible side-tracking of the issue, I would like to say that the terms of reference are confined to determining the best kind of rotation to adopt in Indian Forestry, and I am not considering other applications of the theories of forest finance such as comparison between the rates of interest earned by forestry and other businesses, or the financing of forest projects involving the outlay of capital except in so far as they are directly connected with determining the best rotation to adopt.

The problem may be defined as follows: Should our forests in India be worked to produce the maximum net annual revenue regardless of the rate of interest this represents on the forest capital, or should they be worked so as to produce the highest rate of interest on the forest capital regardless of the reduction in total revenue that this involves? The latter is the "financial rotation" of Schlich, and the other devotees of classical forest finance, but it may take different forms according to how the forest capital is defined.

That the problem is no mere quibble about names but is of vital practical importance is shown by the following figures from Schwappach's Money Yield Table for Scots pine, reproduced from Hiley's "Economics of Forestry," page 173. The forests in question are assumed to have passed the end of the first rotation in each case, have a complete series of age classes on the ground and are in full production:

I.—*"Financial Rotation"* (Rotation of highest interest on capital value of the forest).

Rotation = 40 years.

Annual money yield = 2,950 marks per 100 hectares of forest.

Percentage of yield on capital value = 4.45 per cent.

II.—*"Rotation of highest income"* (for same forest).

Rotation = 140 years (*i.e.* 100 years longer).

Annual money yield = 6,240 marks per 100 hectares of forest.

Percentage on capital = 3.55 per cent.

Thus, in this case, the classical financial rotation gives less than half the annual revenue from the forest as a whole that would be obtained by working on the rotation of highest income. The indications are that similar differences will occur in India, and that in some places (*e.g.*, the Bori teak forests of the Central Provinces, where the price increment for larger sizes is very steep) the differences may be even greater.

Are we then going to be satisfied, when our woods have come into full bearing, with an annual revenue of less than half of what the forests are capable of producing merely to be able to say that it represents a higher rate of interest on the forest capital?

That such a view might be considered correct for private forestry in Europe and incorrect for India is mainly due to the difference between the conditions of forestry as it is practised in the latter country and the imaginary conditions under which the theories of forest finance were developed. The classical methods are primarily worked out on the basis of borrowing money to acquire land and afforest it, and so far as that particular case is concerned, the theories are probably fundamentally sound. (In practical application there is some disagreement about their suitability but that is another matter which cannot be gone into at the moment.)

Let us take two definitions of the classical "financial rotation" and see what happens when they are applied to a normal forest in full production. (The question of improving a forest that is not normal will be considered separately.)

The definition of the "financial rotation" generally given in the text-books is the rotation that will yield the maximum interest on the capital *that has been invested in the forest.* In India our forests are generally in a producing condition and show a steady surplus of revenue over expenditure. It is quite justifiable to say that what little initial costs were incurred in acquiring them and tending them have long ago been wiped out by revenue, and the revenue steadily exceeds the cost of regenerating and managing the crop. If the definition of the financial rotation given above is applied literally, it will be seen that each age-class starts its rotation with a negative cost value and that the whole calculation of the financial rotation becomes meaningless. Some critics may say that each age-class should be

considered separately, and the cost and the interest on it worked out at current rates and brought forward to the end of the rotation. To this I would reply:

(*a*) Regeneration is an essential part of exploitation because, without regenerating, one is not normally justified in exploiting. Regeneration charges should, therefore, be debitable to exploitation just as felling charges are.

(*b*) In any case it does not matter because, if I am to be charged with compound interest on the outlay in regenerating and tending the crop, I must similarly be allowed compound interest on the income produced (as is always done, for instance, for intermediate yields in the formulæ for calculating the financial rotation). Also, the whole forest, *i.e.,* all age classes together, must be considered as a unit, so that there is a perpetual excess of revenue over expenditure. The whole point is that once the forest has reached any static condition, the *time element is eliminated,* except in so far as compound interest might be credited to the forest accounts for excess of revenue in past years. (This is, of course, an absurdly impractical thing to do, but no more absurd than to charge compound interest on money that has not been borrowed outside, but has come out of the forest in question!)

It will be seen, therefore, that the financial rotation of "maximum interest on the capital invested" becomes meaningless when the initial capital has been written off and the forest is regularly producing revenue. It is like a company that has been financed entirely by debentures all of which have been paid off with interest. The only remaining shareholder is the government who collects the direct profits, but there is no *invested* capital left.

The economists, however, are not happy unless they can find some form of capital on which revenue can be considered as interest. All businesses, they say, are judged by the interest they pay on their capital, so forestry must be similarly judged. As the method of "invested capital" has broken down for a continuous forest, they suggest, as an alternative, that the "realisation value" of the forest, *i.e.,* its growing stock and its soil at their present value if sold as a

going concern, should be taken as the capital on which to assess the interest that the forest is paying. The economists then go on to say that financially the best rotation on which to grow the forest is the rotation that gives the maximum interest on this capital value. I must admit that I cannot see any justification whatever for this criterion of the best rotation, and if anyone can point it out I shall be very interested.

It is here necessary to meet another possible criticism which is actually a separate consideration from the above rotation of maximum interest on the capital value of the forest. It involves instead a comparison of the rate of interest earned by forestry with the rate at which money could be invested in the open market. The view is not uncommonly held that unless forestry pays a higher interest on its own capital than the latter would earn if cashed out and invested at current rates, the woods should be cut down and the money so invested. There is perhaps more to be said for this view than some of the others given above, but, except in certain restricted circumstances, it is likely to lead to absurd results.

J. W. Best, in the *Indian Forester* of September 1918, (10) gives an extreme instance of this point of view in connection with the teak forests of the Central Provinces. He collected data regarding increment, volume outturn and prices for different sizes for trees of different ages in the natural teak forests of Hoshangabad Division, and finally arrived at the following conclusions:

A teak tree of average quality, when it reaches 35 years' age is worth approximately Rs. 2-8-0 and is then putting on increment at the rate of 4 per cent. on its own capital value. Four per cent., he says, is the general rate of interest that can be obtained if money is invested in securities. If the tree is grown beyond the age of 35 years, the capital value of the tree increases but the rate of interest on its own capital value decreases. It is wrong, therefore, he says, to grow the tree beyond 35 years, and to illustrate his point he gives the following example:

In 70 years, the tree becomes worth Rs. 7-6-0.

If, instead, the tree is felled at 35 years and another is grown in its place, and if the proceeds of the first tree are invested at

4 per cent. compound interest the following is the position at the end of 70 years:

		Rs.	a.	p.
For the first tree	... ...	2	8	0
„ „ second tree	... ...	2	8	0
Plus compound interest on the revenue from the first tree for 35 years at 4 per cent.		9	12	0
Total	... ...	14	12	0

instead of only Rs. 7-6-0!

It surprises me that this plausible financial argument was apparently never even challenged! Note, that the interest on the tree sold is far greater than the value of the tree itself. Note also that this accumulation of wealth in the form of interest on revenue handed over to the state is going to go on for ever and ever and, according to this theory, has been going on ever since forestry paid its first bean. Followed to its illogical conclusion, one rupee at 4 per cent. compound interest becomes 50 rupees in 100 years, so that all past net revenue handed over by the Forest Department to the state should multiply itself 50 times every century. After one century no more income-tax would be necessary and after two centuries, by which time it has multiplied itself 2,550 times the state would have so much money that it would not know what to do with it! Which, as Euclid says, is absurd!

Take another case: A forest officer some years hence is hauled up before his finance minister who wants to know (in parliamentary language no doubt) why the forest revenue has gone on dropping steadily for the last 30 years or so. He explains to the Honourable Minister that really the financial position is far better than it was then. "It is true," he says, "that the revenue is only half what it was, but the forest capital has been reduced to one-third by overfelling in respect of the annual increment, so that the rate that is now being obtained on the remaining forest capital is higher than it was. It is proposed to go on and reduce the net annual revenue still a little further until the "financial rotation" is reached, when the forest will be giving you the highest rate of interest on the forest capital possible. The excess capital, which was not paying such a

good rate of interest, has been cut down and the revenue therefrom was handed to your predecessors in office. It is presumed that they invested it nicely for you, and that you are now getting a total revenue better than that which you would have been getting if the forest capital had been kept on the ground and produced double the forest revenue." One can imagine the Finance Minister's wrath at such an explanation, and at such ignorance of the elementary economics of running a state! Yet this is what the classical forest economists ask us to do!

The fallacy is, of course, obvious. Money does not beget money at compound interest, except under certain restricted special conditions. In state finance the majority of money is utilised in unproductive expenditure which does not produce interest. Also the majority of money required for such expenditure is obtained free of interest by means of direct or indirect taxes on individual income. A state or province, when living in a normal condition, has a balanced budget. Its expenditure consists of providing certain services for the population so that they can maintain a certain standard of living and consists of such items as the cost of roads, police, sanitation, education and the cost of administration itself. To meet this, the revenue required is obtained from one or two revenue-paying departments such as forests, irrigation, etc., and the balance is made up by taxation of various kinds, including land revenue. All these sources of income are interest-free. Only in exceptional circumstances is the state forced to obtain loans from outside sources and on these interest has to be paid. Either the loans are to finance special industrial schemes in which case the schemes themselves are usually meant to repay the loans with interest from their own profits, or they are to balance sudden changes in the budget due to unforeseen circumstances such as failure of crops or a trade slump, changes which have to be met before alterations in the methods of taxation can be made to pay off the deficit. Interest on such loans has to be found out of general revenues. Money, therefore, that passes through the treasury as general incoming revenue from taxation, forests and other sources does not have to pay any interest as it is a gift and not a loan. And money that passes out does not generally earn any interest as it is nearly all used in unproductive expenditure, and it is, therefore, wrong to assume, for purposes of discussing the forest

finance of state-owned forests, that revenue does or even, in most cases, can earn any interest once it is handed over to the state.

What then is the financial object of management of state forests in India? Surely they should be managed on behalf of the tax-payer as one of the sources of revenue for the state—revenue which goes to relieve him of a little of the taxes he has to pay. Is not the object, therefore, to produce as much net revenue as possible and to give the tax-payer the greatest amount of relief? What does it matter what the capital value of the forest is in its static condition of producing the maximum net income? All that matters, and I am sure that finance ministers would agree, is that in normal circumstances (omitting emergencies such as wars or earthquakes) the forest should be worked on the rotation of maximum net income. This view is endorsed by Chapman, (11) but Hiley emphatically condemns it in a wholesale manner and states that it has "no financial attractiveness." (12) Ask any finance minister in any province whether it had any financial attractiveness!! He would say that it most definitely had, and might even suggest that if any forest officer tried to reduce the regular income from the forests merely to satisfy a theoretical desire to produce the maximum interest on the capital value of the forest, such an officer would be suitably punished by imposing on him and his descendants for ever a special tax sufficient to compensate for the reduction in forest revenue that he had caused!

Is it generally agreed, therefore, that the rotation we should aim at in managing the state forests of India is the rotation of maximum net income? It is hoped that some of those who know more about finance and especially about State finance in India will give their views, and it would be specially valuable to have opinions from some of those who are at present entrusted with the management of the finances of the country.

I may be criticised for having unduly simplified the whole question by considering only the case of forests in a static producing condition. This I have done on purpose as by so doing I believe a truer perspective of the problem is obtained. I had hoped also to be able to say something about the process of improving forests and the finances of bringing them up to a state of full productivity, but lack of space forbids me to go into this at length. Suffice it to

say that such improvement involves putting back a more than normal amount of revenue into the forest again and locking it up for a number of years and this immediately introduces a time element. The compound interest experts can have great fun working out the optimum speed of improvement in terms of interest on the amount of revenue withheld, but practically speaking it is usually a matter of the best policy for the moment, and has to be decided between the administrators of the forest estate and the financial administrators to government. When financial conditions are easy and there is no crisis demanding every available anna improvement should be pushed ahead as fast as the exchequer can afford, while when there is a financial crisis, a temporary halt might be called in improvement, and even, in cases of grave emergency such as a war, it might be necessary to devastate to a certain extent, by cutting into capital. If such emergencies were likely to arise frequently—say once or twice in a rotation, it might be sound politics to build up a certain amount of excess reserve capital to meet them. Another factor which theoretically, should influence the age at which woods are felled, is that of fluctuating market prices. It is obviously good policy to fell rather more heavily when prices are good and to hold back when prices are bad, but unfortunately, state finance demands the exact opposite, *i.e.*, more revenue when general prosperity is low and less when things are flourishing.

It is imaginable, therefore, that various factors such as those mentioned above may influence the rotation to be adopted at any given moment, but any such variations should oscillate about what appears to be the one and only theoretically and practically best rotation for Indian conditions, namely, the rotation of maximum net annual income. Other factors may come in to alter this rotation, *e.g.*, necessity to supply the essentials of life to the surrounding population or to meet certain demands for political reasons, and such considerations may necessitate working on a slightly different and less productive rotation, but, as far as is consistent with such special demands, the rotation should be that which, from the tax-payer's point of view, is the most attractive financially, namely that which puts the greatest number of rupees into the coffers of the state and relieves him of taxes to the maximum possible extent.

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(12) *Vide* (2) above,—Ch. X, pages 161—164, Ch. XI, page 175, and also page 2 of the Introduction.

RAHU: A CHARITY FOREST

BY D. B. SOTHERS.

Practically the whole of the Sind babul forests are situated on riverain areas liable to annual inundation. Some inland forests of babul do exist and Rahu forest is one of these. It is a small forest of 180 acres, about three times as long as it is wide and surrounded on all sides by barrage cultivation. It is described in the Working Plan of 1917 as follows:

> "Babul occurs pure. Almost all the trees are old, unsound and badly hacked. The forest is situated in a lowland in which water stands high and remains some time after the floods have subsided."

This flooding was due to the fact that one of the old inundation canals tailed in the forest, which was used as a dumping ground for surplus water in heavy floods. The forest remained in practically the same state until the Barrage works were opened in 1931. At that time it contained some 800 old trees from six to 18 feet in girth and but very little else. With the advent of the Barrage the old inundation canal was closed. No arrangement was made to supply Rahu forest with Barrage water and in point of fact it has since then received no water except by percolation from the surrounding cultivation and from surplus water spilled into it from the same source. It is, of course, impossible to measure the quantity of percolation water received, but the spill water is estimated by the Range Forest Officer, Mr. Loungani, who has had the area under close observation for the last six years, as at the most the equivalent of a three-inch flooding in the kharif season, and possibly a little more in the rabi. Taking into account the Sind cultivator's views on the duty allotted to the water he receives for his various crops, this is unlikely to be an underestimate. To it must be added a rainfall of possibly three inches average.

The reaction of the Rahu forest to the new conditons was remarkable. At the end of the first two years it was noted that natural regeneration of young babul was coming up all over the extensive blank areas and also in the gaps caused by felling old dying trees in 1931. Additional fellings of this nature were made in 1933 and 1934 and when the forest was inspected early in 1936 the whole area unshadowed by the old trees was seen to be fully covered by healthy young natural regeneration.

It was, therefore, decided to proceed with the removal of the old overmature trees and this work will be completed in 1939. By 1940 it is expected that the whole forest will be fully stocked with babul of all ages from 10 to one year old. The quality of the new growing stock is fully up to that of the best riverain areas: in a six-year-old patch the best tree measured 20 inches girth and 32 feet height, at three-year-old the average height was 14 feet and one-year-old, three feet six inches.

With the trees marked for removal this year, Rahu forest will have yielded, in the period 1931—40, 6,50,000 cubic feet stacked fuel of a value of Rs. 21,000. A return of over Rs. 11 per acre per annum

Rahu from outside. Rabi wheat in foreground.

Young babul, two-year old, right; five-year old, left.

Young babul, two-year old on trench in dry area—the only artificial sowings in this forest.

Old tree 11 feet girth. Young babul two-year old foreground, five-year old background.

is satisfactory from any forest and particularly so from one that maintains itself by charity. An almost similar state of affairs to that existing in Rahu can now be seen in many of the best quality riverain areas wherever these have been subject to regular inundation. This is due to the system of heavy thinnings which has been adopted for the past six years. Previous to this time thinnings were light, and often very little more than the removal of deadwood and windfalls: the present method is considerably more severe as the following table of what is aimed at in the best areas will show:

4-5 years old—ten-foot stick mechanical, leaving about 165 stems per acre.

10 years old	remove	100,	leaving	65	stems per acre.
15 „	„	25,	„	40	„
20 „	„	10,	„	30	„

The standard method of treatment adopted up to the present for babul is clear cutting on a rotation of 30 years followed by artificial regeneration by sowing either with or without the aid of a field crop. But from the present appearance of many of these areas it seems likely that this treatment will require modification. Even if the whole of the crop of mature trees is removed in one final felling at the age 30 it seems certain that at least 33 per cent. of the area will already be stocked by groups of advance growth of approximately one to 10 years old. If, on the other hand, the final felling is preceded by one or more seedling fellings, it appears possible that very nearly full regeneration may be obtained by natural means. Apart from the saving of time thus effected, the young crop will benefit considerably from the protection from frost given by the over-wood. Frost is a constant danger to babul in Sind, and particularly so to the younger classes of 12 feet high and under.

HONAVAR RANGE AND TEAK REGENERATION

BY S. S. DHARESHWAR, RANGE FOREST OFFICER, HONAVAR

Physiography.—The Honavar Range in the Western Forest Division, Kanara, lies between the Sahyadri ghauts in the east and the Arabian sea in the west and between 14°-7′ to 14°-25′ north latitude and 74°-26′ to 74°-46′ east longitude in the south-west of North Kanara District. The altitude above sea level rises as much as 2,620 feet in the east near Malemane Pass and 2,213 feet on the border of Kumta *taluka* in the north and 2,138 feet in the south-east on the Mysore frontier. Girdled thus by hills in the north, east and south, the tract has the form of an amphitheatre in which the bordering large spurs break up into foot-hills and minor eminences scattered up to the coast. From east to west the Range has a greatest length of 20 miles and from north to south a breadth of 17 miles. The total forest area is approximately 184 square miles.

The river Shiravati, which takes her origin in the Mysore State, flows almost through the middle of the tract and meets the sea near Honavar, the chief town of the *taluka*. Two other watercourses, which are the main tributaries of the Shiravati in Kanara, are the Gundbala river and the Tulsani stream, which flow from the northern watershed in a south-westerly direction and join the Shiravati on her right bank within about two to four miles inland from her mouth. The Kalkatti *nalla* is the only tributary stream worth a mention that flows into the river on her left near Gersappa. The Shiravati is noted for the vagaries of her bar. The entrance channel is only about 300 yards broad. The estuary widens into a lake about four miles long (west to east) and three-quarters of a mile to 1½ miles broad. Out of half a dozen islands in the lake, the largest is Mavinkurve which is 2½ miles long and a mile broad, having rich rice lands and cocoanut gardens. The Shiravati is navigable for 18 miles up to Gersappa, which is next to Honavar in importance of trade in the creek. Boats generally up to six tons capacity ply in the river. Sailing into the creek up the pretty Shiravati provides beautiful scenery which continually changes as the boat works its way up negotiating a number of turns. The hill-sides on either banks are sparse of tree growth (since it is minor forest set apart for the exercise of privileges). Up to Gersappa they come almost to the water's

edge here and recede beyond stretches of cultivation there. The thick plantations of cocoanut mixed with areca nut, in places overshadowing little houses, stand silhouetted against the denuded foothills beyond. The boats and canoes moving up and down the waters, the white chapel spires springing up here and there amidst the green canopy, never fail to make the picture appealing in the extreme. Tourists to the Jog Falls often take this river route from Honavar via Gersappa.

The soil near the coast is sandy, changing to sandy loam and laterite loam as one gets into the interior. The loam in the lower hills is enriched by abundance of humus in the semi-evergreen forest. There are some expanses of fertile alluvium alongside the river from the tidal limit near Gersappa to the mouth—a distance of about 19 miles. The soil on the hills subject to the exercise of privileges is very shallow owing to heavy rainfall and want of ground cover to prevent erosion.

The underlying rock near the coast and even to some extent into the interior is laterite which in places is ferruginous and exposed as pure sheet rock. On the high hills it is granitic gneiss and schist. Quartzites and mica schists also occur. Kaolin or white clay occurs in the fissures of the felspatic rocks in the subsoil. Landslides and deep erosions near Samsi—four miles downstream from Gersappa—expose such clay veins. At Berolli four miles from Honavar off the right bank of Shiravati there is a clay mine worked by a Bombay firm. The prepared clay is exported to Bombay where it is used for sizing in cloth mills.

The lower valley of the Shiravati, comprising Honavar Range, being horse-shoe shaped as described above and open towards the south-west, appears to be quite receptive to a greater amount of precipitation during the monsoon which bursts usually in early June and lasts till the end of September. The average rainfall at Honavar is about 148 inches, the maximum in the last 10 years being 174 inches. The rainfall in the ghauts may easily exceed 200 inches. The climate is hot and humid as is generally found on the west coast. It is malarious in the hills. The mean temperature varies from 94° in May to 60° in December.

History.—Honnur, or Naoura, or Honavar, is a place of prehistoric fame and the earliest recorded history of the place (2nd

century A.D.) mentions this as the prosperous capital town of a local chief. The town is situated at the mouth of the estuary of the Shiravati nearly a mile-and-a-half inland from the river bar. The harbour in the estuary now gives anchorage at 125 feet from the wharf to vessels of about 60 tons. Honavar had a fort and a moat of early historical times when it was ruled by local chiefs feudatory to the kings of Vijayanagar and Bednur. In course of time, the Portuguese meddled in the affairs of the local queen of Bhatkal and took up the trade of pepper which was held to be the best of its kind in India. In 1671 A.D. they concluded a treaty with the Bednur king who allowed them to build a factory and a church at Honavar. In 1720 Hamilton notices Honavar or Onor as a port with a river able to receive ships of 200 to 300 tonnage. In 1727 A.D. a small English factory was opened here, the chief articles which tempted a settlement being pepper and sandalwood. A garrison was subsequently built up and infantry was stationed. In Haidar Ali's time, the Company's factory procured every year about 900 khandis of pepper worth Rs. 10,000, the whole sandalwood trade varying from 200 to 300 khandis (of 560 lbs.), betelnut valued at Rs. 40,000 and cocoanuts at Rs. 12,000. As a result of successive wars with Tippu Sultan of Mysore, he destroyed Honavar in 1784 A.D., as in his *opinion foreign trade impoverished a country and gave strangers an* excuse for meddling in its affairs. In 1799, when the district passed to the British, Honavar had not a single house. Five shops, however, were opened and gradually a town developed in the place. In 1862, before Kanara was divided into the two districts of North and South Kanara as they are now, Honavar was a *zillah* station, the headquarters of a sub-collector and a civil and sessions judge. It had then a population of 11,968 which has since decreased to about 7,000.

The second place of importance in the creek is Gersappa which is now a small village on the right bank of the Shiravati about 18 miles from Honavar. Nearly a mile-and-a-half south-east of Gersappa are the extensive ruins of Nagarbastikeri, or old Gersappa, which was the capital of the Jain chiefs of the place (1409 to 1610). Once an opulent town with its haunts of luxury this place was believed to have consisted of thousands of houses and 84 temples lined against narrow streets. The innumerable partially silted up tube-

Ruins of a Jain temple (Chaturmukh Basti) in Kalkatti Forest near Gersappa, which once formed part of the prosperous Capital City of the Queen of Gersappa in the sixteenth century. Now one of the protected monuments in the Forest.

like wells of dry masonry, and the scattered mass of stone rubble of ruined buildings found in the locality now overgrown with tangled forest, add pathos to the scene. The centuries old magnificent trees, proudly standing amidst the ruins, bearing witness with complaisance to the continually unwinding film of human destiny, humble the pride of man who, in order to pursue his ambitious ends, is tempted to envy the longevity of these monarchs of the forest. Some of the temples now find protection under the Protected Monuments Act. The chief object of interest is the cross-shaped Chaturmukh Basti (plate 49) with four doors and four symmetrical life-size stone images of a Tirthankar placed back to back in the centre facing each door. The chiefship seems to have been very often held by women as almost all the writers of the 16th and early part of the 17th century refer to the queen of Gersappa who lived also at Bhatkal at times. The last queen in the early years of the 17th century was Bhairadevi who was called the "Pepper Queen" by the Portuguese traders. She married a foreigner of low extraction who betrayed her cause and she was deprived of her kingdom by her overlord, the king of Bednur. She died in 1608 A.D. In 1623 the Italian traveller Della Valle describes Gersappa as once a famous city, the seat of a queen, the metropolis of a province fallen to ruin and overgrown with trees.

Part of the area occupied by the ruins was cleared of the forest and regenerated with rubber plants 30 years ago. This plantation, having been found unsuccessful from a commercial standpoint, was removed and teak introduced in the place some 20 years ago which is thriving now.

The road from Gersappa to Talguppa in Mysore State—27 miles—runs across the Malemane Pass in the Sahyadris and was opened in 1854 A.D. by the Madras Government at a cost of Rs. 78,500. The export from Gersappa consisted chiefly of pepper, spices, areca nut, rice, sandalwood and *ragi* transported from the upland places like Sirsi, Siddapur and parts of Mysore.

The Forests.—Out of the total forest area of 184 square miles, 52 square miles have been classed as minor forest and set apart for the exercise of privileges by the local agriculturists. Eighty square miles of the reserved forest have been organised into four different Working Plans. The Forest Settlement was carried out between the

years 1889 and 1897 and the resettlement in 1920—22. The privileges are regulated by the Kanara Forest Privilege Rules of 1st June 1925.

The forests may be classified into the following three broad types:

I.—*Pure Evergreen* with an irregular top storey in places occurs on the Sahyadris or the Western Ghauts which usually descends down the main spurs into the damp valleys. The component species common in this type are: *Alstonia scholaris, Artocarpus hirsuta, Artocarpus lakoocha, Calophyllum tomentosum* and *wightianum, Carrallia integerrima, Chickrassia tabularis, Cinnamomum zeylanicum, Diospyros* spp., *Dipterocarpus indicus, Eugenias, Garcinia indica, Holigarna arnottiana, Hopea wightiana, Lophopetalum wightiana, Machilus macrantha, Pterospermum heyneanum, Melia dubia, Tetramelos nudiflora* and *Vitex altissima.* Natural regeneration of some of the above mentioned species in this type does not seem to succeed in places subject to intensive suppression and bad drainage. The undergrowth consists of a tangle of canes, climbers and palms such as *Caryota urens* and *Arenga wightii.* Wild pepper which possibly spread from cultivated pepper in olden days occurs here and there in this forest. The natural regeneration of the species of economic importance can, however, be helped by gradual removal of overhead suppression and improving light conditions to a modicum.

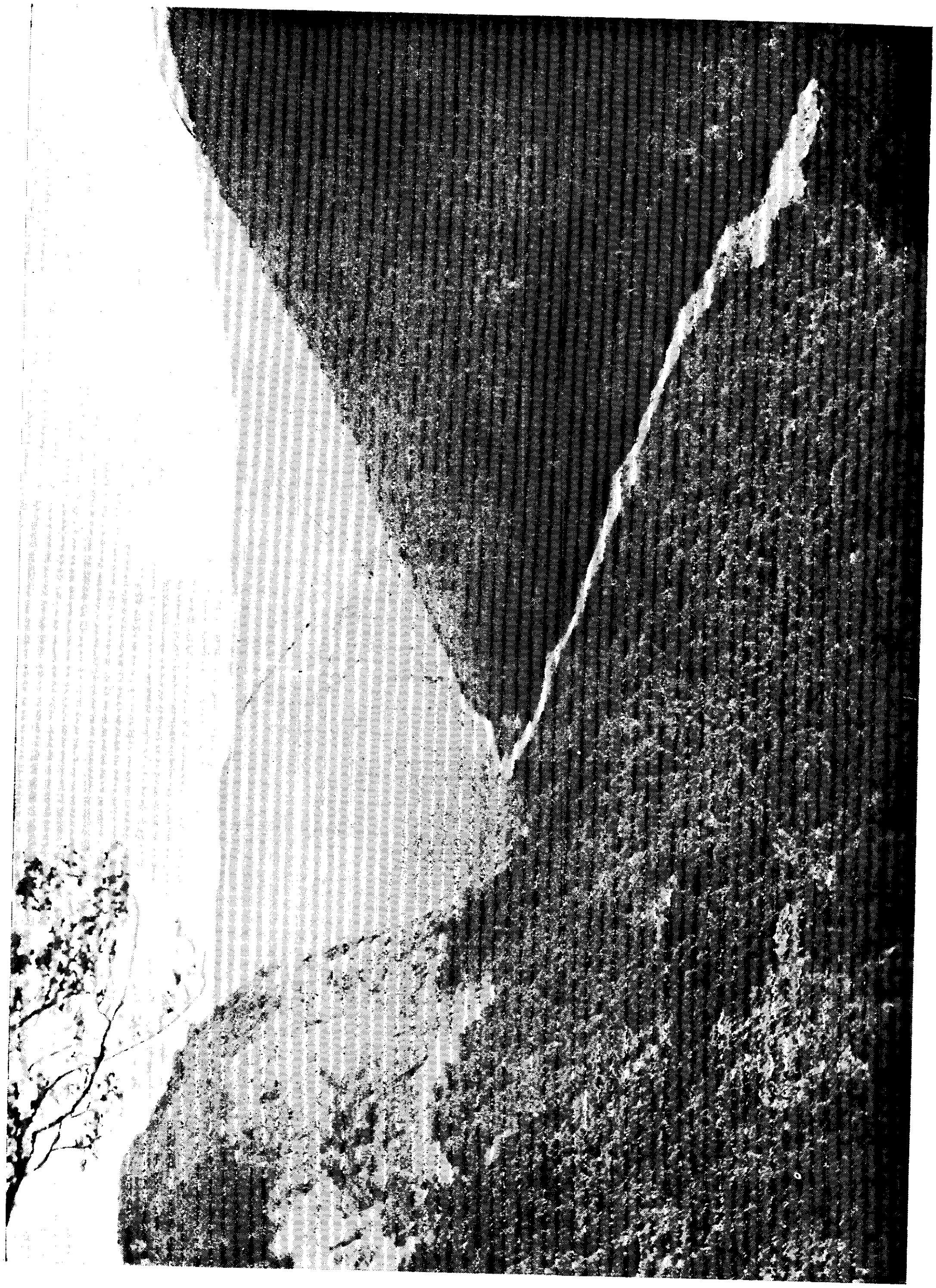
II.—*Mixed Deciduous Forest.*—This is common on the lower ridges and foot-hills and often yields place to semi-evergreen in moist situations and in hollows on the hill slopes. It is interesting to find teak growing sporadically amidst this type particularly in Nisalnir, Balemet and Murgoli forest to the south of the Shiravati and on the southern slopes of the main spur of the Sahyadris on the northern border of the Range. Patches of teak of varying extent also occur in the Shiravati valley below the Malemane Pass along the right bank of the river (Plate 50) and in the neighbourhood of Taltot near Gersappa. It is also found

almost on the fringes of evergreens often overtopped by shade-bearing species and even in the Tali-palm forest. Teak in favourable situations here attains a height of about 100 feet and a girth of over six feet. Natural regeneration of teak is conspicuous by its absence for obvious reasons. The nature of distribution of teak in its natural condition shows—its occurrence near abandoned cultivations apart which might be artificial—that it flourished possibly when the conditions were more deciduous in the pertinent localities ages ago and that the forest has since been tending towards evergreen. That this type of forest is proclimax is also definitely indicated by the transition stages which have been well marked in places by an evergreen understorey which may outgrow the deciduous species. The principal species which occur in this type are: *Adina cordifolia, Bombax malabaricum, Dalbergia latifolia, Hopea wightiana, Lagerstrœmia lanceolata, Lagerstrœmia Flos-Reginae, Pterocarpus marsupium, Terminalias, Strychnos nux-vomica, Tetramelos nudiflora, Vitex altissima* and *Xylia xylocarpa*. Some of the useful species, *viz., Hopea wightiana, Pterocarpus marsupium* and *Eugenias* are very prolific in natural regeneration, successful tending of which should never be a problem as these forests are practically immune from fires.

III.—Scrub Forest.—This consists of the populated parts of the reserved forest classed as minor forest at different times according as the demand for it arose and set aside for the exercise of privileges by the local agriculturists. As a matter of fact, this type represents the relic of as good a forest as Type II and its present condition is obviously due to the abuse of privileges by the villagers who are mainly dependent upon it for drawing their supplies for agricultural use. This fact is borne out by the presence of fairly distributed evergreen species over the area, chief among which are *Strychnos nux-vomica* and *Eugenia jambolana*. The former being a reserved species has the legal protection and this is how it could survive its associates in spite of the mutilation it has been subjected to

by the villagers. The indiscriminate hacking often coupled with *kumri* or shifting cultivation in the past gradually thinned the stand out, driving it ultimately to safer places in difficult ravines where small patches of semi-evergreen can still be seen. Pressure of constant grazing demand by village cattle under such conditions and the annual fires lighted with the object of promoting growth of grass, set back the plant succession and even rendered it stable, promoting drier conditions in the outlying tracts. *Acacia catechu* appeared now on the scene and established itself over a considerable area. *Terminalia chebula* or the *hirda* tree followed. These being reserved species are now abundant in favourable situations even as the *nux-vomica* and yet they are not free from being badly pollarded. It appears that in this type of forest there occurred abundant sandalwood in the past on the outskirts, which fact finds a mention in the *Kanara Gazetteer* as follows: "The sandal tree is indigenous to the rocky hills of Honavar and if allowed would grow to a tolerable size; but the wood is so valuable that the tree is cut before it grows at the most to a foot broad." Possibly an uncontrolled removal of the species in the 16th and 17th centuries practically exterminated it from the locality long ago. A relic of it is still found in the thin sandal that is sparsely scattered in the forest of Gunvanti and Manki near Honavar.

On the whole, the minor forest presents a pitiable sight indeed. The hilly configuration and the open conditions brought about as aforesaid lead to heavy soil erosion during the monsoon. Cultivations below the denuded hills get silted up, soil æration is hindered and the crops are adversely affected. Watercourses in these bare areas which otherwise irrigate the gardens in the valleys get diminished in flow. The underlying rocks are exposed and the soil is badly furrowed, giving little scope for the vegetation to recuperate. The impoverished soil yields but a very poor quality of grass. The thicker forests beyond do not always provide good grazing. And even where they do, the cattle do not resort to such places owing to the prohibitive distance and the menace of wild animals. The cattle brought up



The Shiravati Upper Valley, overlooking Malemane Ghat. The ridges on either side of the gorge (height 1,300 feet above sea-level) in the immediate front form part of the main Sahyadri Mountain Chain through which the Shiravati rushes down towards the sea. The flat to the left just above the bend in the stream in the lower middle distance contains sporadic teak growth. Difference in altitude between river-bed and top of the Sahyadris is 1,220 feet.

A view of bare and stony part of minor forest restocked artificially by the owner with *matti, kindal, honni, jamun*, cashew, *avla* and sandal in the hedge. Age 16 years, height 30 feet and average girth 15 inches.

under these conditions are poor specimens. Better breeds introduced from outside soon degenerate. Yet the people seem slow to realise the gravity of the causes that precipitate the situation. Clamour for further extension of the minor forest is no remedy for the evil. The control measure lies in restoring the soil cover to optimum conditions by way of propagation of useful species of grasses and fodder plants including a scheme for rotational grazing wherever possible and a judicious exercise of the privileges, actuated of course by the conscious belief that the prosperity of the cultivator in a forest tract depends as much upon the economical use of his forest as on anything else. Individual assignments in the minor forest to improve its condition wherever feasible can be attempted with success, because instances are not wanting here in which the landowners have been trying to restock the bare areas in their charge with such species as *matti, honni, kindal,* cashew, *jaman, avla,* sandal and even teak. (Plate 51.) Yet even in such controlled areas, *matti—Terminalia tomentosa*—is subject to ruthless stripping of bark by fishermen who use it to dye their nets. To make the masses, therefore, realise their responsibility towards forest conservancy, the management of the minor forest can better be transferred to Village Panchayats under official control in regard to only technical matters inasmuch as pure official propaganda, which is viewed with suspicion by the ignorant public, would never be successful.

Working Plans.—Part of the reserved forest in the Range has been organised under four different Working Plans. In an ascending order they are described below:

(*i*) *The North Canara Coast Fuel Working Plan.*—The total area of the minor forest included in the Honavar Town Firewood Depot Plan is 2.63 square miles. The object of the Plan is to supply a sustained yield of approximately equal quantity of fuel after meeting the demands of the privilege-holders who are entitled to take small timber and poles each year in advance of the regular fellings. The annual requirements of the Honavar Firewood Depot are now about 500 tons. The purchaser of the annual coupe who is also the contractor to run the depot during the year has to sell the fuel at a rate not exceeding annas 4-6 a maund of 80 lbs. The annual coupe averages 42 acres. The average price obtained per acre is Rs. 10. This Plan

has, however, been abandoned recently by order of Government as a result of popular agitation that the minor forest should not be exploited to feed the depots lest its area should be diminished, although during the Revision Settlement additional reserved forest was converted into minor forest in order to provide for the area included in the Plan with the definite object of working the forest so organised for the fuel depots mainly for the convenience of the local people.

(*ii*) *Honavar Tali-Palm Forests Working Plan.*—The forests lie on the southern slopes of a large spur of the Sahyadris that stretches along the northern border of the Range, the configuration being very hilly and precipitous. The climate is malarious. Much of the area is depopulated, the only people that inhabit it being a few *kumri* Marathas. The Plan includes 39 square miles of reserved forest containing a fair distribution of Tali-Palm—*Crypha umbraculifera.* It is very gregarious in favourable situations. Dense evergreen is the predominating type of forest which yields place on the lower slopes to moist deciduous. The Tali-palm is principally valued by the poor people (and even by men of means of the backward class) for its pith from which an edible flour is prepared. The Tali leaves are used for thatching and fencing and when tender for making umbrellas, etc. The nuts are used by local carvers who make vegetable ivory bead necklaces out of them. Recently an industrial school has been established at Honavar which utilises the seed or nuts in button manufacture. The average pith-yield of a palm may be taken as 30 head-loads. The average flour yield per palm is 1,050 lbs.

The Tali-Palms are exploited on selection system, only bulbous or mature Class I palms being felled for pith in accordance with the prescriptions of the Plan. The calculated annual possibility is 1,800 mature palms. The marked palms are sold to purchasers at a permit rate of Rs. 2 per palm. They are given free to *kumri* Marathas at the rate of one palm per adult and one-third

palm per child with the restriction that the pith is used for the grantee's own use and not for sale or barter. Deserving persons other than *kumri* Marathas are also granted free palms on application. The average revenue per year is Rs. 1,500. According to recent Government orders all classes of poor people get the palms free of fees provided every applicant produces a certificate from the Mamlatdar that he or she is poor. It is, however, hoped that this concession would not prove to be a false blessing, because the indolent among the tenantry, who can usually be classed as poor, would thus find an easy means to earn their year's bread by storing the pith which, after all, provides the least nutritious food, and so neglect cultivation. Profiteering by way of illicit sale of the flour is also a possibility. The grant of one palm per adult which has an average yield of 1,050 lbs. of flour is undoubtedly bounteous, inasmuch as 200 lbs. of flour a year can be taken as the average requirements of an adult, because the Tali flour is used always in combination with other cereals like *ragi* or rice. The landed class has already begun to apprehend the disastrous effect of more land going out of cultivation in the years to come in the areas affected by this concession which would otherwise have been deservedly made in the case of only the landless classes who have no solid means of subsistence. What in actual practice happens is that even the *kumri* Marathas, who are more dependent for their food upon this flour than any other class of people, usually avail themselves of less than half of the grant sanctioned in their case and distribute the resultant pith between themselves. A possible modification of the concession, therefore, would be to grant half a palm per adult and one-third per child under 12 years of age of only to the landless poor. As it is desirable to discourage the use of the flour for food as far as possible, the sale of the palms may be totally prohibited.

(*iii*) *Working Plan for the Casuarina Plantations.*—The *Casuarina* plantations along the sea front to the north and

south of the Shiravati river bar are included in Felling Series III which is one of the several Series constituting the Plan. The area is 543 acres worked on a rotation of 20 years. As stated in the Plan, *Casuarina equisitifolia* is an exotic and was first introduced here in the year 1882. The plantations add to the scenic beauty of the foreshore in addition to serving as a protection against erosion and high winds and storms.

The mature wood is exploited chiefly for fuel, which is exported to Mangalore and Bombay. The gross revenue per acre is about Rs. 145 and the expenditure is Rs. 75 and the net return is Rs. 70. The annual coupe averaging 27 acres is sold standing and fetches a price of about Rs. 115 to the acre. The clear-felled area is regenerated artificially by putting out plants in June and July from wet nurseries raised in advance. The espacement adopted is 12 feet by 12 feet quincunx. The transplants are watered in the year of formation from November up to the burst of monsoon in the following June. Average initial cost of formation is Rs. 24 per acre. The average outturn per acre comes to 22.8 tons (of 100 cubic feet) in the final felling and 2.17 tons in the first thinning and 3.62 in the second thinning. The annual revenue from the *Casuarina* coupes is approximately Rs. 3,500.

(*iv*) *Working Plan for the Below Ghat Inland Forests.*—This is the most important out of the four Plans in that it has for its scope the largest revenue-yielding area in the Range, covering nearly 38 square miles of moist deciduous forest such as described in Type II above. This Working Plan was introduced in the year 1928.

The object of management is to convert the inferior jungles into a teak-bearing deciduous forest. The exploitable age is determined with reference to the rate of growth of teak. The ring counts of naturally grown teak show that the tree takes about 80 years to attain an average girth of four feet and in very favourable situations a girth of nearly six feet is attained in 90 to 100 years. It is the opinion of the writer of the Plan that the soil conditions are unsuit-

able for the production of large timber and, therefore, a rotation of 80 years has been adopted as a tentative measure.

The method of treatment prescribed is clear-felling with artificial regeneration of teak, either in groups or on intensive scale. The closure prescribed for exploited coupes is 10 years. "The possibility is fixed by area and fellings are prescribed for a period of 20 years so that the situation may be re-examined after this period and the prescription revised in the light of experience gained." The annual coupe averages 45 acres. The average price per acre realised is about Rs. 24 and the average annual revenue from the coupes sold in Blocks XI to XVII included in this Range is about Rs. 10,200.

Some of the coupes do not sell owing to the inferior nature of the growth. Such coupes are prescribed to be clear-felled departmentally or through the agency of the *kumrivallas* (shifting cultivators) and regenerated with teak, as they will not improve by keeping and are best cleared and regenerated with teak.

5. *Artificial Regeneration of Teak.*—As has been described already the nature of the stand is mixed deciduous merging for the most part into semi-evergreen—a proclimax forest, the climatic climax being evergreen. There can also be found evergreen patches in the area in moister situations in the ravines. The object of the Working Plan being conversion of this inferior forest into a timber-producing teak-bearing deciduous area having a mixture of at least 50 per cent. teak, the prescription is that not less than one-third of the area of the annual fellings is to be regenerated with teak. It is the option of the coupe purchaser, however, to clear-fell and burn more than one--third area of his coupe which he usually does where he finds a good mixture of hardwoods for fuel. The remaining area in every coupe is selection-felled, only trees over 3½ feet in girth at breast-height being felled for logging.

The regular artificial regeneration of teak dates back 20 years, that is, prior to the introduction of the present Working Plan. In those days, the method of regeneration employed was chiefly in combination with *ragi* (a kind of millet) through the agency of *kumrivallas* who reaped the crop free in return for the teak plants raised. There are some genuine *kumri* plantations among the pre-Working Plan regeneration areas. These were undertaken evidently as an experiment in remote places like Kembal, Yelkotga, Hukli and

Tumboli in the Tali-palm area. The result obtained has been splendid. The tree growth in these areas was felled by the *kumri* Marathas and burnt and teak regenerated by way of sowing the treated seed which was supplied by the Department. After the introduction of the Working Plan, some of the remote areas clear-felled as a condition of the coupe agreement, were regenerated under the agri-*cum*-forestry method mentioned above. The cultivators were required to burn the slash and either sow or transplant teak in combination with *ragi*. The dibbled seed was destroyed often by rodents. The cricket pest being a common feature in these parts, the seedlings were subject to attacks by the insect and repeated attempts have had to be made in replacing the casualties before the plantation could be fully stocked. This phenomenon increased the expenditure in a departmental plantation to as much as Rs. 24 per acre, the minimum being rupees eight. Whereas, in the *kumri* plantation the expenditure on seed supply amounted to as much as rupees four per acre, the minimum being rupee one. Teak in mixtures with *matti, honni, sissam* and *savan* was tried in the past. The result has not been encouraging in that the teak has been suppressed mostly by the other species. The hardwoods are planted now in separate patches, or lines, in the regeneration areas, according to soil conditions suitable to each species.

Pursuant to recent modifications in the conditions of the agreement, the coupe contractors are required to burn and reburn the clear-felled areas. Planting of stumps of one-year-old dry nursery seedlings has been resorted to for the last six years or so. The stronger shoots withstand the insect-pest better and the casualties are very few. The cost of formation per acre has been reduced in the case of both the methods of regeneration as shown below. The figures are recent three years' average:

COST PER ACRE

Departmental or on direct labour.	Rs.	a.	p.	*By kumri or Agri-cum-Forestry.*	Rs.	a.	p.
1. Seed, nursery and stump supply ...	0	14	0	... ...	0	14	0
2. Planting ...	0	12	0	... ...	...		
3. Three weedings and earthing up ...	2	14	0	Construction of huts	0	2	0
Total ...	4	8	0	... ...	1	0	0

The yield of *ragi* per acre of plantation having an espacement of nine feet by nine feet varies from 3½ to 10 *khandis* (17-*paili* measure). *Ragi* sells at rupees three per *khandi*. Calculated at Rs. 2-12 per *khandi* at the threshing floor in the coupe, the gross yield per acre is worth from Rs. 9-10 to Rs. 27-8. Deducting therefrom the cost of formation as otherwise would be incurred in the case of departmental plantation which is Rs. 4-8, the net return per acre realised by the *kumrivallas* amounts to anything between Rs. 5-2 and Rs. 23 according to the condition of the crop. The *ragi* crop at times fails in which case provision is made to pay a reward to the planters to compensate their loss.

6. *Advantages of Kumri Plantation over the Departmental.*—By "*kumri*" is here meant the genuine *kumri* in which the original stand is cut down and burnt in the shifting cultivation fashion. Regeneration by this method has a decided advantage over the plantations raised by departmental agency which are done on moderately burnt areas. There seems to be, however, a certain amount of prejudice against *kumri* plantation in some quarters. But the results so far achieved in this method of regeneration of teak should lend support to the view that, far from deriding it, one should encourage it under the conditions obtaining here. The conversion of the original stand, such as it is, is not possible without setting back the plant succession. This can best be done by intense burning (as against a mild burn) of the felled material. The lop and top does not always provide sufficient material for a heavy burn after satisfying the requirements of the agriculturists in the vicinity who are privileged to remove the branch-wood under six-inch girth at the thick end.

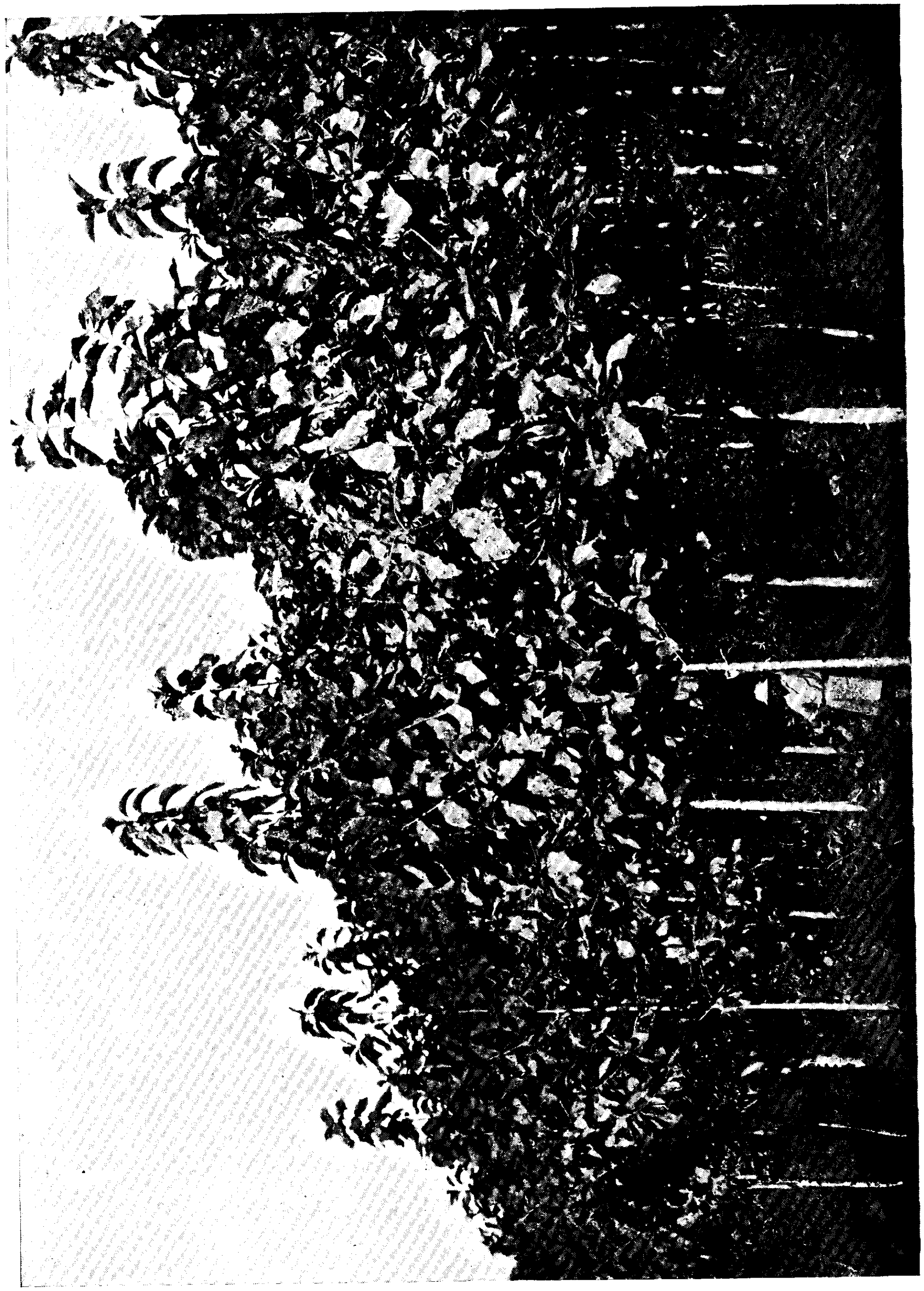
The half-burnt or moderately burnt areas, when regenerated with teak by departmental agency, no doubt show a satisfactory result in the infancy of the plantation. Within about five years, the area is invaded—in spite of the annual cleanings—by inferior jungle woods that formed the original stand, overwhelming the teak. Ultimately, the original teak lines are intercepted here and there, driving the teak to form groups of varying extent in congenial places. Such groups, too, are not free from further suppression and constant elimination of teak goes on imperceptibly. One out of several such instances here is the Kalkatti plantation raised by

departmental agency in the year 1920—espacement 12 by six feet—in which an average test plot of an acre now consists of only 181 stems including a few dead and malformed stems removed in the past. Result as this is clear enough to support the findings of the Javan experiment that teak in intimate mixtures does not thrive.

As a contrast, teak raised under agri-*cum*-forestry method in heavily burnt evergreen stand is not suppressed by the regrowth of jungle woods for some years after start. The intensity of fire destroys the recuperative power of the stools of the inferior species, let alone their dormant seed. The thick humus layer and the soil acidity are destroyed and the soil is thus exposed, affording little scope for the evergreen species including canes and palms to reappear (Plate 52). What seems to be the retarded condition of the teak plants in the first year of the *kumri* plantation is possibly due to the close crop of *ragi* which promotes root competition. But under proper supervision and conditions of the "Kabulayat" to be executed by the *kumrivallas,* the teak in an espacement such as nine feet by nine feet can be kept free from the choking *ragi*. As a counterpoise for the possible root competition, however, the crop of *ragi* tends to effectively control the run-off during the heavy rains in this hilly tract. On the other hand, the effects of soil wash-off are quite perceptible in the regeneration areas which fail to get a soil-cover in time to withstand the rigours of the downpour in the first season in a plantation raised by direct labour departmentally. The wilted condition of the plants noticeable in the first sultry season in the departmental areas, which is evidently due to the enriching of the lime contents of the soil after a burn without a proper soil cover to control the evaporation of soil moisture, is not noticeable in a *kumri* plantation which has the *ragi* stalks still left in it to conserve the soil moisture, to promote soil æration and to fertilise the soil as they slowly deteriorate. What appears, therefore, as the retarded condition in the initial stage of the *kumri* plants is only the time taken by them to establish a strong root system in a soil rendered more porous and friable by a heavy burn as can be seen from the comparatively stouter stems which eventually outgrow those in a departmental plantation in the fifth year (Plate 53).

Therefore, the initial condition of the teak plants in a *kumri* and the state of the soil practically free from jungle wood regrowth

One-and-a-half year old teak plantation in C. 9-XVI, raised with *ragi*—espacement nine by nine feet after a heavy burn of slash left back in a semi-evergreen stand. Note the dense soil cover of a herb of (N. O. *Compositae*) and absence of regrowth of original stand. Average height 16 feet and average girth 6 inches.



Three-year old teak plantation raised with *ragi* in coupe 6-XVII in 1935. Espacement 12 by 6 feet. Average height 30 feet, average girth 11 inches.

in the first year need give no cause for any misgivings as regards the future of the plantation which has a long life to adapt itself to the environments by fostering deciduous conditions favourable for hardwoods to show up and gradually form the understorey. This has sufficiently been vindicated by the *kumri* plantations in Tumboli, Kembal, Yelkotga, Adkekuli and Sampoli, started as early as the year 1918 by the late Mr. M. S. Tuggerse, the then Divisional Forest Officer, South Division, Kanara. The splendid result is simply captivating.

In order to compare the rate of growth of the departmental plantations with that in the *kumri* areas, the actual measurements of heights and girths were recorded in several plantations made since the year 1918 down to 1938. For every year, one plantation of each of the types grown in identical physiographical conditions was selected in different blocks. All abnormalities and freaks were avoided and heights and girths of stems in half to one-acre plots in average crops recorded. Curve I in the appended graphs refers to departmental plantations. Curve II for *kumri* plantations shows how the growth overtakes that in the departmental areas and continually progresses towards an average height of 70 feet and a girth of 31 inches in 20 years. On the whole, the rate of growth compares very favourably with the best real high forest plantations in Yellapur and Ramanguli Ranges in this district.

The result, therefore, leans much in favour of a heavy burn in localities tending towards an evergreen climax which undoubtedly serves the object of replacing the inferior and evergreen species with useful deciduous ones below the teak, giving the latter at the same time full scope for development. Secondly, the *kumri* method of regeneration satisfies the need of the *kumri* Marathas and other poor people who always clamour for *kumri* in otherwise prohibited forest. The *kumri* plantation would serve to some extent as a check over the Marathas intending to migrate to the Mysore territory for want of local facilities for *kumri*. Thirdly, a speedy and economical way of attainment of the object of the Working Plan, when funds for artificial regeneration are getting meagre. Speedy because, where it does not pay a coupe contractor to clear-fell more than one-third area of the coupe, the *kumri* cultivators may be persuaded to do more than the modicum of felling. It may also be possible to get

the *kumrivallas* to do the felling of the unsold coupes of the inferior stand bit by bit and regenerate the areas as contemplated in the Working Plan.

7. *Espacement for Planting.*—As regards the espacement, nine feet by nine feet has been found to be the best suited out of several spacings tried in the past 20 years. The reasons in favour of this are as follows:

(1) There is neither the grass nor bamboo menace in these parts as it is in the greater parts of the upland forests of Kanara which are decidedly dry and therefore a closer espacement in such localities puts down the pest and shades the ground.

(2) The original stand being semi-evergreen, early closing up of the canopy results in maintaining shady conditions (and these should be avoided here in the interest of deciduous recruitment) which in their turn promote the regeneration of evergreen species that smother the teak. More open conditions conduce to rapid decomposition of litter and accelerate the air capacity of the soil, giving less scope for semi-evergreen species to appear below the teak. It is desirable that attention be paid to the possibilities of invasion by such inferior species in the teak plantations in these parts. Therefore, a six by six feet espacement may be conveniently avoided in most situations. The Javan experiment finds that "mixtures which shade the ground densely can influence the growth of teak unfavourably."

(3) Economy in initial expenditure on formation and reduced number of thinnings.

(4) Delayed first thinning which may be needed in the eighth year instead of the fifth as is the case with a six by six-foot espacement.

(5) The larger number of marketable poles derived in the first thinning. Poles up to 12 inches girth at breast height have practically no demand.

(6) Rectangular espacement such as twelve by six feet gives lop-sided development to plants which is difficult to rectify in subsequent tendings. Hence it is not recommended.

(7) Yet it is also desirable to have some laxity regarding the adoption of espacement: In a clear-felled area, some stretch of soil otherwise poor in quality is at times included. Such localities and steeper slopes require closer spacing such as six by six feet to promote shade conditions and soil cover in view of soil improvement.

(8) In an espacement of nine by nine feet, four thinnings can be conveniently done before the ultimate number of stems are left to reach maturity as shown herein below:

I	Tninning at 8th year	= 12′ 7′ × 12′ 7″	Diagonal	269	stems left.
II	Do. 15th ,,	= 18′ × 18′	Square	134	do.
III	Do. 25th ,,	= 25′ 5″ × 25′ 5″	Liagonal	67	do.
IV	Do. 40th ,,	= 36′ × 36′	Square	33	do.

The number of thinnings is thus reduced, giving, at the same time, maximum scope for the stems to attain full development, commensurate with the growth of the best teak found locally in its natural condition which has an average espacement of 32 feet and an average girth of five feet three inches and an average height of 85 feet. An espacement of eight feet by eight feet would be a convenient alternative to one of nine by nine feet affording as many facilities as the latter. In this espacement eight by eight feet the ultimate number of stems in the fourth thinning would be 42 and the espacement 32 by 32 feet.

To sum up, the result of artificial regeneration of teak in the Shiravati lower valley by either method and particularly by agri-*cum*-forestry has been most gratifying and may be persevered in right earnest. To counterbalance the annual reduction in the area to be planted with teak which has now been prohibited within a mile of villages according to recent Government orders dated November 1938, the forests in the depopulated valley of Gundbala stream forming part of the Tali-palm area can be organised for timber exploitation and regeneration of teak.

8. *Financial Results.*—The annual gross revenue of the Range varies from Rs. 18,000 to Rs. 20,000 according as the timber and fuel market stands in a year. The expenditure on works is about Rs. 4,000 and the establishment cost amounts to approximately Rs. 10,500. The surplus thus is between Rs. 3,500 and Rs. 5,500 which has since been reduced owing to the abolition of the grazing

fees (Rs. 800) and of the permit fees on Tali-palms (Rs. 1,200) ordered by Government recently. The net return is therefore Rs. 1,500 to Rs. 3,500. There is ample scope, however, for the enhancement of the revenue from these potential forests in case new avenues for exploitation such as plywood industry, shuttle manufacture, charcoal burning, etc., be explored in the near future.

My thanks are due to Mr. W. de C. Walsh, I.F.S., Conservator of Forests, S. C., who kindly suggested to me the recording of the girths and heights in larger sample plots in each year's plantation and the appended graphs are drawn according to data so collected.

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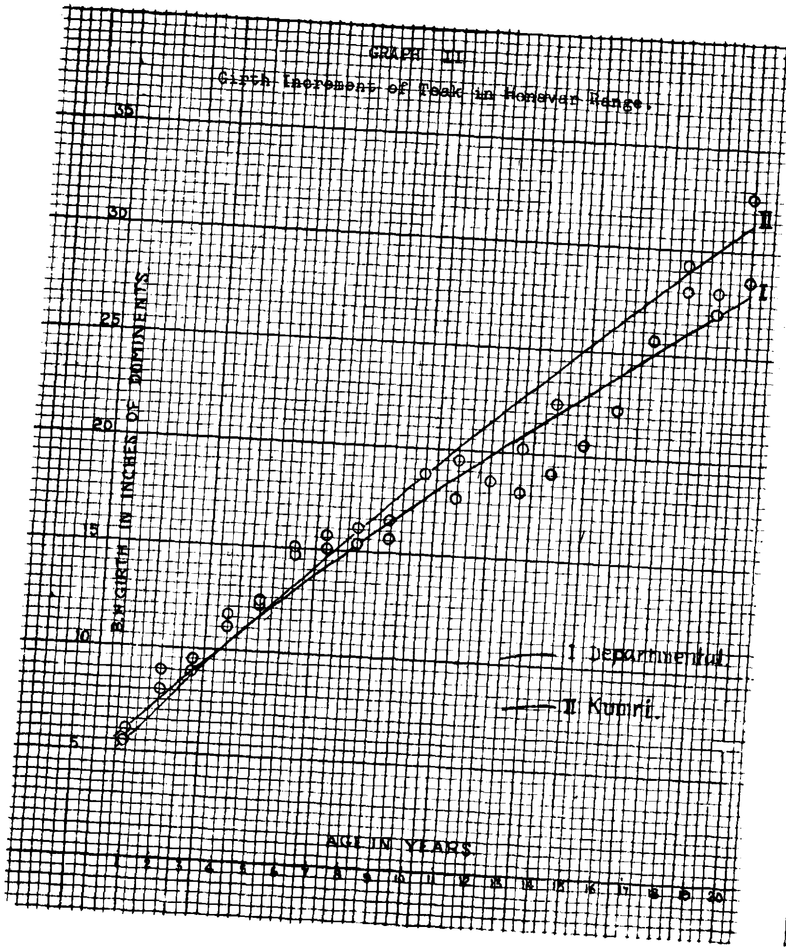
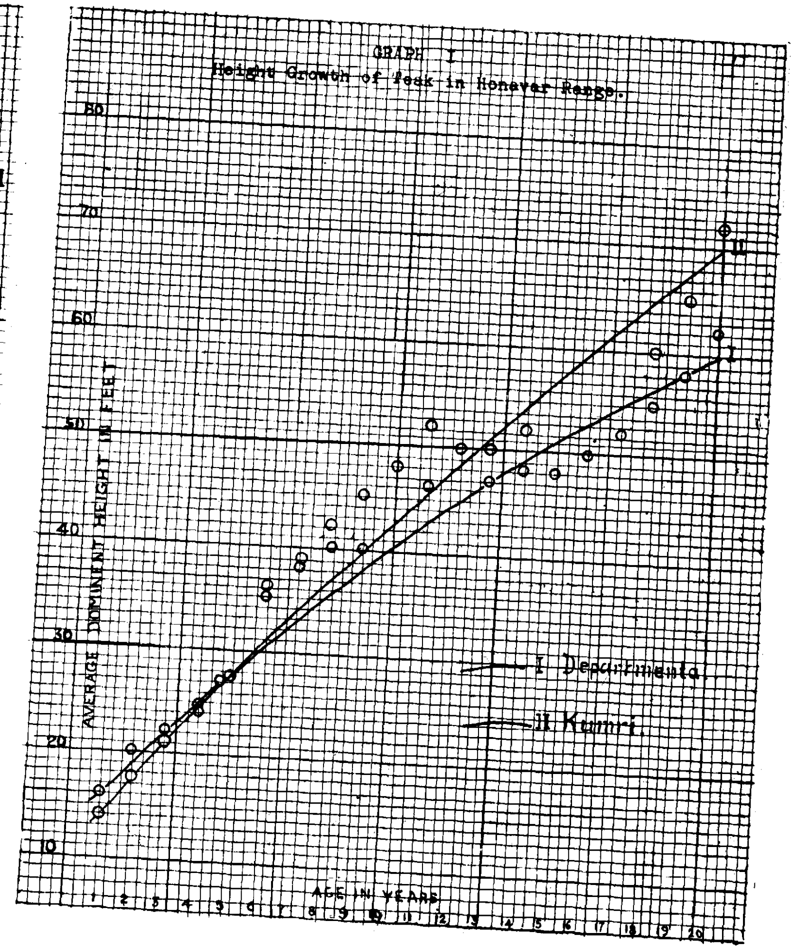
MAKING BETTER GRAZING AVAILABLE IN OPEN PASTURE FORESTS

By K. P. Sagreiya, B.A., B.Sc. (Oxon.), I.F.S.

Grazing in the government forests, on payment of nominal rates, is a privilege that has been enjoyed by the people of the Central Provinces and Berar from the earliest times. Grazing and production of timber are demands on land which can overlap only to a limited extent, after which the balance of Nature is so upset that both the forest and the pasture begin to deteriorate; therefore, regulation of grazing in the forests is rapidly becoming a major problem of forest management. The incidence of grazing in the forests classed as *Open Pastures*, and comprising over 6,000 square miles, out of a total area of nearly 19,000 square miles of reserved forest, is in places as heavy as two animals per acre. The areas are practically devoid of tree growth and the grass in them has so deteriorated



GRAPH III
Girth Increment of Teak in Honavar Range.



GRAPH I
Height Growth of Teak in Honavar Range.

as a result of continuous and unrestricted grazing that they have become mere exercising grounds for the cattle.

It is the constant endeavour of the Central Provinces Forest Department to improve the fodder yield from these lands to make better grazing available and eventually to accommodate a larger number of animals and thus ease the incidence on the *Tree* Forests where the present incidence is endangering the future supplies of timber and fuel. The main obstacles in the way of improvement are:

(1) Complete disregard by the people and the leaders of public opinion of the fact that grazing at nominal rates (of one to two annas per animal per year) results in a vicious circle of heavy grazing, poor cattle and decreasing supplies of fodder, because it gives an impetus to promiscuous breeding of uneconomical cattle, which in turn become a serious drain on the already meagre fodder supplies of the province.

(2) Restrictions in the shape of limiting the incidence or periodically keeping cattle out to allow pastures to get better stocked with grasses are resented by the public as so much privilege taken away from them.

(3) The open pastures are extensive, their present condition deplorable, and funds practically non-existent. Intensive methods of improving the pasture, such as weeding, manuring or reseeding, are therefore impracticable.

(4) The number of cattle seeking admission in the reserved forests is steadily increasing, mainly due to very cheap grazing rates and to a less extent on account of the rapid depletion of private grazing grounds as a result of unrestricted and continuous grazing.

Even in the face of these seemingly unsurmountable difficulties the Department is sparing no trouble to provide as much grazing as is possible without impairing the future supplies. Thus, attempts are being made to find out the optimum grazing-closure cycle (in whole years) and the maximum permissible incidence that will con-

serve and, if possible, improve the yield of fodder. Pioneer work has been done by the Central Provinces Forest Department in this line. The data collected so far have, however, failed to give any conclusive results, mainly due to the multiplicity of extraneous uncontrollable factors the influence of which completely swamped the differential effects of various treatments compared. The experiment has shown that definite conclusions are not likely to be obtained unless the investigation is repeated on a considerably larger scale and for a number of years. Indications are that the cost may not be commensurate with the value of results obtained, and even if the ideal treatment is found, it may prove impracticable, *e.g.*, a very light incidence or a very long closure. The necessity for tackling this problem from an entirely new view-point has, therefore, arisen. Two possible remedies suggest themselves:

(*i*) breaking the vicious circle of cheap grazing and increase of uneconomic cattle, by commercialising grazing; utilising the increased revenue for improving the pastures, and then diverting more cattle to the open pasture forests and saving the tree forests and

(*ii*) devising practicable methods of improving the fodder yield; educating public opinion for the need of such restrictions, and encouraging the habit of stall-feeding.

Of these, the first remedy is not likely to appeal to the people or the leaders of public opinion who have always looked upon grazing as a prescriptive right which must be allowed to be exercised on payment of nominal rates. The second is therefore the only remedy left in the hands of the Forest Department, and two alternative schemes are suggested here. These are as under:

Scheme "A."—Rotating cattle on a pasture on a four-monthly cycle and allowing rest to grazed areas according to their requirements.

The grazing ground should be divided into a convenient number of *pasture units* of such size that any area in a unit will be conveniently accessible to cattle in any season. Two thousand to 4,000 acres, depending upon the nature of terrain, either in a com-

pact block or preferably in three separate blocks, all conveniently approachable from the villages "listed" to them, will perhaps be the most suitable size. When the three areas are in a compact block they should be sub-divided by permanent natural features, preferably ridges or *nalas,* which are difficult to cross. These sub-divisions may be called *Paddocks* I, II and III.

The grazing year can be divided into three grazing seasons, which, for the sake of convenience, will be referred to as—

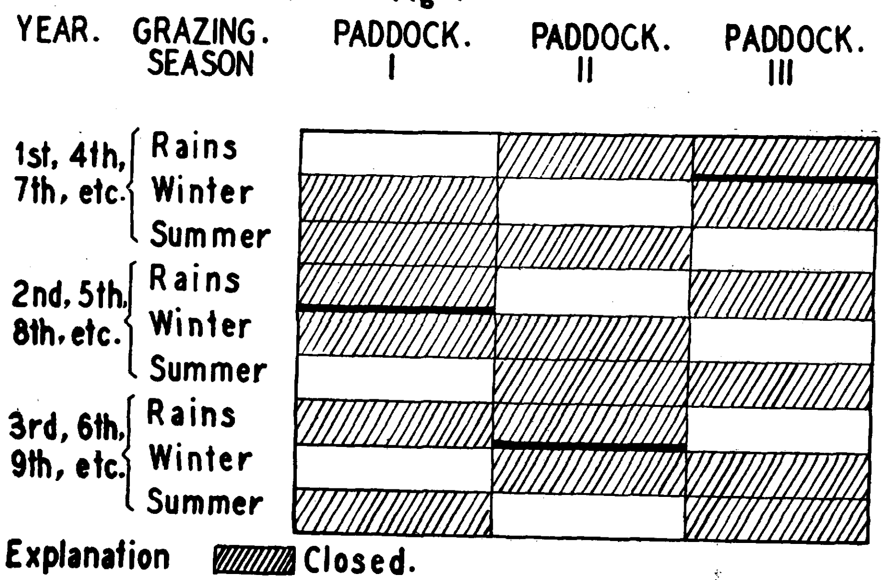
Rains, *i.e.,* July to October,

Winter, *i.e.,* November to February, and

Summer, *i.e.,* March to June.

Under the proposed scheme the cattle should be rotated on the three paddocks in the manner indicated in Figure 1—This is only a diagrammatic representation: the actual boundaries of the paddock will depend, as mentioned above, on the nature of the country.

Fig. 1



This arrangement has the following features:

(*a*) Of the three paddocks *one and only one* will be grazed at any time, *e.g.*—

1st year	...	Rains—I,
		Winter—II,
		Summer—III,
2nd year	...	Rains—II,
		Winter—III,
		Summer—I, and so on.

(*b*) At the end of the main growing season, *i.e.*, at the end of October, one paddock will always contain grass for stall feeding, *e.g.*—

1st year	...	III,
2nd year	...	I,
3rd year	...	II, and so on.

(*c*) Eventually all paddocks will be subjected to the same treatment on a three-year cycle and the successive "grazes" on a single pasture will be in winter, rains and summer.

(*d*) After a paddock is grazed in the rains, which is the most destructive grazing, it will remain closed for 12 months when grass over it will be available for cutting. After this it will again remain closed for another four months. The perennial grasses will thus have ample time to recuperate their lost vigour and the annuals will have a chance to get established. Grass cutting after the rains has the additional advantage that re-sprouting will take place when the dew falls in winter, which will not be the case if the mature grass is left standing, or if the paddock is continuously grazed. After winter grazing a paddock will receive four months' closure during summer and the perennial root-stocks will re-sprout and new plants that will come up after the pre-monsoon "mango showers" will have a better chance of surviving till the commencement of the monsoon and will thus increase the stocking density.

(*e*) Grass is cut after 12 months' complete closure, during which period weeding, reseeding, manuring or burning experiments can be tried.

The prescriptions for the entire pasture unit arranged in a table are:

Year	*Season*	*Paddock grazed*	*Cut grass in October from*
1st—4th, etc.	Rains	I	III
	Winter	II	...
	Summer	III	...
2nd, 5th, etc.	Rains	II	I
	Winter	III	...
	Summer	I	...
3rd, 6th, etc.	Rains	III	II
	Winter	I	...
	Summer	II	...

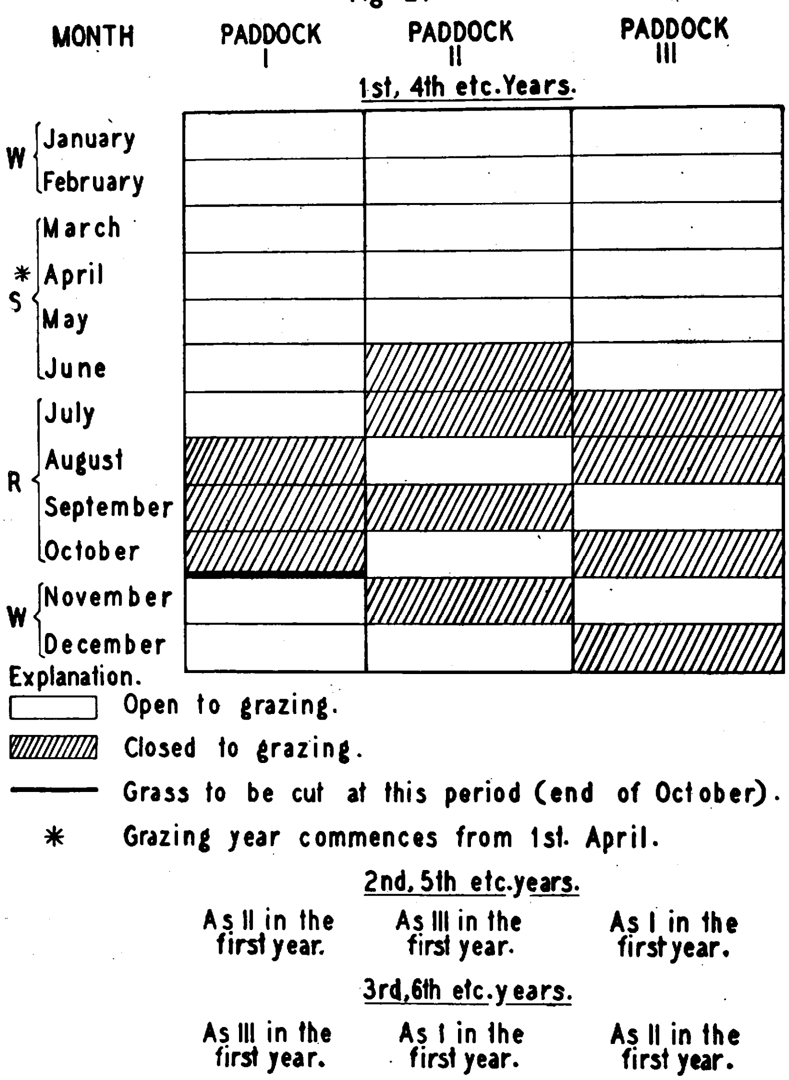
It is true that under this scheme the incidence of grazing will be trebled. But whereas at present the cattle are sent to these areas as it were to allow them to stretch out their limbs or to clear the conscience of the owners that they have done well by the animals, under the proposed scheme definitely better grazing will be available throughout the year and enough grass obtained for stall-feeding. In other words, the animals will be better nourished.

As regards the practicability of the scheme, it is suggested that the closures, etc., should be left entirely to the villagers themselves and the forest officers should merely act in an advisory capacity. Departmental management is likely to be resented by the people, not so much because of the curtailment of the available grazing area as the fear of being harassed by the forest subordinates, should animals stray into closed areas.

Scheme "B."—No closures during early summer (March, April and May) and late winter (January and February) when grass is scarce. Only one-third closure during late summer (June) and early winter (November, December); two-thirds closure during rains when grass is available in abundance; monthly shifting of animals from paddock to paddock during the rains to minimise damage to pasture which is most susceptible to trampling in this season.

As before, the pasture unit should be divided into three paddocks and grazed as shown in Figure 2.

Fig. 2.



N.B.—If grazing pressure is very heavy, the closures in November and December could be done away with. Of course, the benefit to the pastures will be proportionately reduced.

The main features of this arrangement are:

(*a*) The entire pasture unit will be open to grazing throughout the latter half of winter and the first half of summer (January, February, March, April and May) when grass is scarce.

(*b*) Two out of three paddocks will be open to grazing during the early monsoon period (June) and first half of winter (November and December) when less grass is available.

(*c*) One out of three paddocks will be open to grazing during the rains (July, August, September and October) when abundant grass is available.

(*d*) In October each year grass will be available for stall-feeding in one paddock.

(*e*) Provision is made for allowing tender grass plants to get established during the pre-monsoon period (June, July) in one paddock and during monsoon (July, August) in another and thus increasing the density of stocking.

(*f*) As rains grazing is the most destructive, only two out of the three paddocks will be grazed in this season, the third remaining closed. Of the two grazed paddocks, only one will remain open at a time for a month, the other being rested.

As pointed out under Scheme "A," the arrangement of closures should be left to the people themselves. To avoid confusion amongst cattle owners, three posters should be prepared, one for each paddock, showing the months during which they are to remain open to grazing and these should be shifted from one paddock to another in April (commencement of the new grazing year) when all paddocks are open to grazing, so that by June when closures are to commence the people will know how these are to operate.

It is hoped that readers of the *Indian Forester* will examine the proposed scheme, indicate its drawbacks, and suggest improvements.

TIMBER PRICE LIST, MAY-JUNE 1939
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 33-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-1 to 1-5-0 per c.ft.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Re. 0-15-7 to 1-3-3 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-2-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-12-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-12-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-4-0 per c.ft
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Re. 1-3-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-14-0 to 1-8-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 1-2-0 to 2-5-0 per c.ft.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Re. 0-8-6 to 1-4-0 per c.ft.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Re. 0-10-0 to 1-4-0 per c.ft.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 75-0-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-5-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs	
,, ..	,, ..	,, ..	M. G. sleepers	
,, ..	,, ..	,, ..	B. G. sleepers	
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-8-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Re. 1-0-0 per scantling.
,, ..	,, ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	
,, ..	,, ..	U. P. ..	Logs	
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-14-4 to 2-4-4 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-10-6 to 2-12-6 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 1-8-0 to 2-10-0 per c.ft.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

EXTRACTS

DRAFT GRAZING RULES FOR THE PROVINCE OF BOMBAY

The following draft of revised rules which the Government of Bombay have under consideration for the regulation of grazing in the forest districts of the Province of Bombay is published for the information of all persons likely to be affected thereby. Any objections or suggestions should be forwarded to the Chief Conservator of Forests, Province of Bombay, Poona, so as to reach him not later than 28th February 1939:

I.—*Introductory Statement of Objects*.—(*i*) Uncontrolled grazing is inevitably wasteful since the cattle trample more than they eat as they roam round searching for the most succulent grasses. This

selective feeding also leads to deterioration of the pasturage since the best grasses are eaten down again and again, being given no chance to seed, while the inferior grasses are left to spread and multiply. Therefore, where land is properly managed, uncontrolled grazing can only be permitted if the supply is so greatly in excess of the demand that the grass crops automatically receive sufficient rest for seeding and regrowth without any organised control of the cattle. In very many parts of Bombay Province the pressure upon available grazing grounds is so great that not only has the quality of the grass crops deteriorated, but serious depletion of soil fertility and even extensive erosion has developed so that much of the land which is under Government's direct control is in imminent danger of complete denudation and destruction. Careful management of these lands and close control of the animals utilising them is therefore an urgent necessity for the welfare of the agricultural communities of the Province.

(*ii*) In organising proper control of grazing there are twofold difficulties with which to contend. Not only has the supply to be conserved and developed but it also has to be distributed as fairly as possible among many contending claimants. This second set of difficulties is particularly acute where all the available land has suffered serious degradation through excessive grazing in the past. Carrying capacity in such cases is exceedingly low and an almost fantastically large acreage may have to be devoted to a quite small number of cattle in order to permit the ground to recuperate. The improvement of land and the proper management of land always means doing several things properly. It never means doing only one thing properly. For the restoration of maltreated grazing grounds limitation in numbers of cattle admitted to graze is not enough. Erosion must be checked by banking along contours and grazing must be controlled by sub-division of the available pasturage for opening and closing on a simple rotation during the monsoon months. The details of the most suitable methods, and combination of methods, of management necessarily vary greatly in different localities and the correct solutions of the varied problems can only be of local application. This is similarly the case in deciding the best distribution of available grazing among conflicting claims. Conditions vary in every locality. Rules for the control of grazing, therefore, cannot prescribe

uniform, hard and fast procedure for the whole Province. Only general principles can be laid down, which should be interpreted and expanded into detail with discretion according to the local circumstances in each case.

II.—*Free and Unrestricted Grazing by Cattle in Open Forest.*—All lands in charge of the Forest Department shall normally be open to free and unrestricted grazing by cattle, except that specified areas may be closed to grazing for purposes of regeneration of the tree-growth for a term of years, as sanctioned by Government in accordance with the provisions of working plans or under any executive orders of the Collector of the district. There shall, however, be no closure to grazing within a quarter of a mile of a village (*gaothan*).

Note.—This rule applies to cattle owned by persons *bona fide* resident in the Province. Cattle owned by non-residents shall pay a fee of Re. 1, sheep and goats As. 4.

III.—*Conditions for Imposition of Control.*—But in any localities in which Government are satisfied that the pressure of grazing is liable to cause erosion, or loss of soil fertility, or deterioration of the crop of grass and consequently reduction in the quality and quantity of available grazing, control shall be organised in accordance with the following principles:

(*a*) *Preference for Cattle Essential for Economic Agriculture.*—In providing facilities for grazing over Government lands preference shall be given to cattle essential for the economic agriculture of the locality. The number of cattle deemed essential for cultivation and for the domestic needs of the resident agriculturists in any village shall be fixed for each locality on consideration of the average size of a holding, the average number of cattle usually maintained proportionate to the acreage under cultivation and of any other relevant factors, so that for each village, *taluka*, or other convenient unit there may be fixed a proportion between the acreage under cultivation and the number of cattle essential for economic working, *e.g.*, four acres per head, so that a village with 1,600 acres under cultivation requires 400 "Essential" cattle. The Collector, advised by his officers of the Agricultural and Forest Departments, shall fix this proportion for the whole of his Collectorate, each *taluka*, a group of villages, or even for each village, as he may consider necessary.

(*b*) *Distribution of Ranches.*—It shall be the duty of the Forest Department to allot as far as possible grazing grounds of sufficient size for the Essential cattle of each village. Areas thus allotted will be known as "Ranches" and should be as adjacent as possible to the village concerned, subject to fair distribution between rival claimant villages. This obligation to provide grazing for Essential cattle will normally apply only to villages which have Government lands in charge of the Forest Department within their boundaries, or whose boundaries adjoin such land. In exceptional cases other villages may also be included, provided that they are situated sufficiently near to the available grazing grounds to make full use of them; that no village with a better claim suffers shortage in consequence; and that the acreage allotted per head is not thereby reduced below the fair carrying capacity. Such cases will be rare as these principles for control will be applied generally only in localities where the pressure of grazing is already clearly excessive. Moreover there is obviously a limit in distance from available grazing areas beyond which village cattle cannot be expected, or wish, to travel.

(*c*) *Calculation of Carrying Capacity of each Ranch.*—The basis of all control must be the estimated number of cattle which can be admitted to graze over any given area without causing deterioration. This, in turn, will depend upon other methods of management adopted, such as rotational closure, contour banking, manuring and so forth as well as upon climatic and physiographic conditions of the locality. The size of the ranch, or ranches for the Essential cattle of each Entitled village, therefore, shall be calculated in acres per head according to the quality of the grass crop at the time of allotment. For localities with high rainfall (approximately 50 inches per annum or more) the standard figure for areas carrying crops of good quality, free from erosion, shall be two acres per head and in areas of low rainfall (less than 50 inches per annum) shall be three acres per head, provided that rotational closure is enforced during the monsoon months. On areas eroded and of poor quality, or where rotational closures cannot be enforced the acreage per head will be proportionately greater according to the needs of each case. In the event of the demand for grazing being very

great and the available area quite inadequate, some initial decrease of the proper acreage per head may be unavoidable. The standard rates, however, should always be regarded as the ordinary minimum in each case.

(*d*) *Distribution of Permits.*—The total figure for Essential cattle in any Entitled village having been decided as laid down in section (*a*) and a ranch, or ranches, of appropriate size having been allotted to the village in accordance with sections (*b*) and (*c*), the distribution of permits to graze shall be made in units to the individual cultivators by the local officers of the Revenue Department. The basis of this distribution shall be the actual acreage cultivated. Owing, however, to differences in the size of areas available and to the need for suitable boundaries for subdivisions, the acreage allotted to a village will seldom correspond precisely with the exact acreage calculated as necessary for the number of Essential cattle. Consequently, the carrying capacity of the ranch, or ranches, will seldom divide exactly into the acreage under cultivation and the opportunity should be taken to accumulate any surplus fractions into extra units. These can be given to village *kamgars,* who live by services rendered to the village and who have little or no land to cultivate.

(*e*) *Penalties for Unauthorised Entry.*—Officials of the Forest Department will be in no way concerned with the details of the distribution to individuals of permits for grazing. It will, however, be the duty of the Forest Department to supervise the actual grazing so that the numbers admitted to a ranch at any one time are never allowed to exceed the limit fixed according to the carrying capacity of each ranch. To facilitate this supervision metal tallies with chains will be issued with the permits. Each tally will bear a number corresponding to the number of the permit. Any animal found within a ranch without a tally, and any animal found grazing in an area closed under Rule II, will be liable to be impounded. Alternatively compensation may be recovered under the provisions of the Forest Act, such compensation not to be recovered in addition to the pound fees except in cases of deliberate trespass. This section will be applied also in enforcing rotational closures during the monsoon months under any approved scheme of rotational grazing.

(*f*) *Public Ranches.*—When ranches have been set aside for the Essential cattle of Entitled villages, any surplus areas will be formed into "public" ranches which will be available for the cattle of wandering graziers, and for any other cattle not already provided for, on payment of fees. The more accessible areas having been allotted to neighbouring villagers, these public ranches will usually be in the interior of considerable blocks of land in charge of the Forest Department. In these ranches there will be no preference given to any particular class of animal except that the mere fact of remoteness will automatically tend to favour those belonging to wandering graziers over those which may come from Entitled villages, being in excess of the Essential number, and still more over those from other Unentitled villages. Limitation in total numbers to the approved carrying capacity will be enforced in these public ranches as in all other ranches. The issue of permits for grazing in these ranches will be made by local officers of the Revenue Department as under (*d*) except that fees will be charged for the permits per head of cattle as under:

Buffaloes, cows, oxen, horses, donkeys, mules.	Sheep if allowed.	Goats if allowed.
Rs. a. p.	Rs. a. p.	Rs. a. p.
0 8 0	0 4 0	0 4 0

In the event of demand for grazing in any of these public ranches exceeding the carrying capacity, the Collector of the District will decide how the permits should be distributed. As far as possible, the whole of any herd belonging to a wandering grazier should always be provided for in one ranch and not be forced to split up.

IV.—*Admission of Sheep.*—Grazing of sheep can only be permitted over areas specifically made available for this purpose. If sheep are admitted to graze in any area organised under Rule III, sheep must be counted against the limit of carrying capacity for each ranch opened to them. For the purpose of this calculation, four sheep shall count as one cow. Only the public ranches should be opened to sheep under normal circumstances and special arrangements will invariably be required to fit their grazing into a rotational scheme in such a way that it does not interfere with the use of the ranch by cattle.

V.—*Goats.*—Grazing of goats is prohibited, except that goats may be admitted with sheep as flock leaders in a proportion not exceeding one goat to every 50 sheep.

VI.—*General Note.*—In all planning for social improvement it is essential to provide a proper balance between what the community requires and what the individual thinks he needs. Uneducated country folk in India are still very largely individualistic in outlook. Appreciation of the requirements for progress of each village community as a whole is still in its infancy. When an individual owns a number of cattle and has been accustomed to graze them in lands controlled by the Forest Department, he frequently expects to be able to continue to do so even though this involves all the cattle of his village, including his own, obtaining far less nourishment than the land is capable of producing under proper management. The principles for the control of grazing laid down in these rules involve the introduction of two restrictions upon the entirely undisciplined liberty which has hitherto been enjoyed. These are the limitation of numbers admitted to graze in any particular area and the limitation of periods of utilisation under rotational closures during the monsoon months. It is essential, therefore, that when first introducing control of grazing, a careful compromise should be adopted between the ideal and the present practice. This is particularly the case in allotting ranches. Strict adherence to the principle which limits the obligation for supplying grazing only to the number of cattle calculated as essential is ideal, but where present herds are largely in excess of this number, some latitude should be allowed in the first instance. On the other hand, such latitude should not be so excessively liberal that other villages are penalised or that no grazing is left available for the herds or flocks of wandering graziers, which undoubtedly in some parts of the Province play a useful part in the economy of the countryside. In allocating ranches in lands controlled by the Forest Department, consideration should also be given to the possession by a village of any alternative sources of grazing such as *gairan* or Revenue Waste numbers. Full co-operation between all Government Departments concerned with rural affairs is essential for success. Primary responsibility for all actual management of the land, including assessment of the carrying capacity of ranches, choice of numbers and size of pastures into which ranches should be divided, fixing of rotations

for opening and closing the pastures during the monsoon months, and all other details of management which affect the productive capacity of the land will rest with the Forest Department. The Revenue Department will be directly responsible for distribution of grazing permits up to the total carrying capacity of each ranch, for deciding what villages should be included as Entitled to grazing, what number of cattle should be deemed Essential in any village, and whether all or what fraction of this number should be provided with grazing in a case of shortage of supply.

A. C. HILEY,
Chief Conservator of Forests,
Province of Bombay.

POONA:
1st *December* 1938.

"AFFORESTATION FOR THE CONTROL OF MALARIA"

By C. Strickland,

Professor of Medical Entomology, School of Tropical Medicine, Calcutta

The article by Dr. Gorrie in a recent number of this journal entitled "The Problem of Soil Erosion in the British Empire with special Reference to India"* has stated the case for afforestation from the economic point of view. It is hoped here that a public health aspect of the case will add to the interest of the subject.

There can be scarcely any necessity to cite authorities for the statements that the deforestation of the hill tracts everywhere has led to an unduly rapid run-off of the rainfall from the land; that where the rivers debouch from the hills to the plains, there have ensued destructive floods from which the affected landholders have sought to guard themselves by a system of embankments; that there has been gross denudation of the soil in the hills, leading to the starvation of all living things; and that there has been a corresponding excessive deposition of heavy sediment at the foot of the hills that has sometimes put out of cultivation many square miles of land and lessened the navigability of the rivers. For instance, one reads in Mr. Robertson's *Settlement Report of Bankura District in Bengal*:

*Gorrie, R. Maclagan: "The Problem of Soil Erosion in the British Empire, with Special Reference to India." *Journal of the Royal Society of Arts*, lxxxvi, pp. 902—24. See also Warren, W.D.M., I.F.S.: "Effect of Forests on Erosion, Floods, Climate and Rainfall," *Indian Forester*, July 1936.

"The last great flood was in the year 1320 B. S., when the whole area between the Damodar and the Bodai was submerged and some area even to the south. The villages in this area remained submerged for a full four days and the current was so strong that men and cattle were carried away. In one village, Ajaipur, it is said that only one man was saved alive. The whole of the submerged area was covered with sand and has remained unculturable to this day.

During the flood the waters forced a channel which ran through the village of Narayanpur and joined up the two tributaries of the Damodar—the Sali and the Bodai. The result is that the low-lying area of the adjoining villages of Jalijala, Maherpur and Nahala becomes a vast stretch of water during the rains, on which no crops can grow. The area is locally known as 'Hajamat.' Formerly it produced excellent paddy but is now lying waste.

The river was formerly navigable throughout the year to a distance of about 90 miles from its mouth; as a result of the gradual silting up of the river-bed, it is now navigable for about 25 miles only."

Now in Bengal, the consequent necessity to embank the land has been considered almost universally to have been a potent factor in the present great amount of local malaria that would otherwise not have been able to rear its Hydra head as it has done; this view perhaps fallaciously implying that, in the event of there having been no embankments, there would have been livelihood for any inhabitants in these tracts.

Under the circumstances, any measure being undertaken in the hill tracts with a view to delaying the unduly rapid run-off of the rainfall and reducing the so-called torrential rivers to the standard of meadow-rills, should deserve the particular attention of those who think the subject of great importance from the point of view of the prevention of malaria. Such a measure has been put in train in the hills of the Province of Bihar.

The Conservator of Forests to the Bihar Government, Mr. Owden, of the Indian Forest Service, actuated primarily by the economic point of view, has recently initiated an experiment on regeneration

and improvement of the dry hill-type *Sal* (*Shorea robusta*) forests of Chota Nagpur. He has seen the terrible state to which they have been reduced by the treatment to which they have been subjected in the past, and continue to be subjected by the improvidence of the zemindars and rayats; he has seen the effects of the lack of any conservancy methods, and of forest fires often deliberately started out of malice or in the false belief that burning improves the grazing; and he has considered that the evils which have developed could be combated by irrigation.

A system for this purpose has consequently been installed at selected places by damming nullahs, at points as high as possible in their courses, to ensure a sufficient supply of water being headed up to lead into contour trenches 1½ feet wide, which, perhaps after a journey of many miles encircling a hill or a range of hills, come back to the points whence they started. The dam in the nullah bed allows for an escape of any water that is more than nine inches deep in the trench.* The dam at the escape is protected from undue scour by an apron of tarred canvas or some other cheap device, and there has actually been no difficulty in execution or maintenance. The cost has been about Rs. 100 per mile.

An area of about 100 square miles of country has been thus treated and is under observation, and from a forester's point of view Mr. Owden is satisfied with the thickening and improvement in the growth of the crop and the regeneration that has ensued. If the forest of verdant green seen by the writer, as compared with the burnt-up bare straggling unirrigated areas, be any criterion, then the results from the economic point of view must be very good; for instance, many more maunds† of *sabai* grass, which is a valuable undercrop, have been garnered since the irrigation was started. Mr. Owden also notes a decrease in the diurnal variation of temperature and that the meteorological improvement has not been confined to the area directly influenced by irrigation.

It is, of course, mainly from the point of view of the hold-up of the rainfall so as to render the flow in the rivers more equable that

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* It is now suggested, however, that the width of the trenches should be 2½ feet, and the depth increased by six inches.

† One maund=80 lbs.

the malaria man is interested, and this experiment, conducted over an area of 100 square miles will show what can be done. The rainfall will perforce be conserved on the land by the irrigation channels that will slowly feed and raise the subsoil water "table," and not only this but the improved growth in root and leaf of the forest and its thick carpet of herbage and rotting leaves will delay the run-off from the land into the nullahs, as has been recounted a thousand times by those interested in physiography. These delaying factors will then lead to a more equable flow in the streams from their source to the sea with a consequential improvement in the condition of their bed and banks; to a diminution in the excessive deposition of silt in the plains; and to a preservation of fish-life that would delight the heart of any modern Izaak Walton.

This altered regimen in the rivers (as well as the fact that the heavier growth of plant life everywhere in the irrigated area should naturally inhibit the livelihood of the dangerous anopheline mosquitoes and should lead to a decrease of malaria locally) will make its beneficial influence felt far afield where at present, as in Orissa and Bengal, the torrents work havoc.

Locally, the heavier growth of plant cover will naturally inhibit the livelihood of the dangerous anopheline mosquitoes and lead to a commensurate decrease of malaria. We know now that, generally speaking, the dangerous anophelines have no use for shade.

At present the local malaria rate is very high. The villagers in these uplands are intensely malarious, one village—Roro—yielding a spleen-index of 100 per cent., the degree of splenomegaly appearing to be roughly related to the distance of a village from a stream. The peasants, perforce, have to live near a perennial stream, because wells are expensive and dry up during the hot months, because, as pointed out above, all rain-water has run off the land instead of soaking underground to provide for seepage in the hot months. Sometimes water is conserved by means of the so-called *bandhs*, constructed by throwing up an earthen dam across the line of drainage of a shallow valley in a tract where all jungle has been destroyed and where there would, in the hot months, be no running water. Here the subsoil water is naturally nearer the surface, a factor that prevents the *bandh* drying up too rapidly.

One infant Ho* that the writer saw (on April 2nd, 1938) had a "three-finger" spleen.† It had been born in December 1937, and was said to have developed fever three weeks afterwards. This case would seem to prove that mosquito infections occur in these hills at about 2,500 feet during the cold weather, unlike the Himalayan foot-hills where they do not occur. The temperature and humidity records are available:

AT RORO

1937-38.	*Maximum.*	*Minimum.*	*Humidity.*
November	... 87.2	58.5	81.4
December	... 80.1	47.9	82.9
January	... 82.9	55.8	88.8
February	... 82.5	51.8	82.8

The Orissa Flood Committee in 1928 made numerous suggestions for the amelioration of the condition of the flooded tracts of the Mahanadi and Brahmani deltas, but, unfortunately, did not stress sufficiently the potentialities of flood control by water conservancy in the highlands. What Bengal and Orissa want, from an economic point of view—and this coincides luckily with the malaria point of view—is a more equable flow of water in the rivers and the new procedure reported above seems to be the best way to attain it. In fact, Bengal and Orissa should watch closely the results of these measures, because not only does Bihar locally stand to benefit but also other distant Provinces.—*Journal of the Royal Society of Arts, No.* 4505, Vol. LXXXVII, 24th March 1939.

SPEECHES AT THE MADRAS FOREST COLLEGE, 2ND JULY 1938

The prize distribution over, Mr. C. C. Wilson, the Chief Conservator of Forests, made the following speech:

"MR. RAJAGOPALACHARIAR, LADIES AND GENTLEMEN,

We have listened with interest to what the Principal has told us of the activities of the students at this College during the past year.

Let me refer first to the students and to the career which they have chosen.

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* The Hos are the local aborigines.

† It was nevertheless a splendid morsel of humanity.

It is one of the finest careers there is, as it has as two of its main objects the improvement of the face of the country, and the preservation of the fertility of the soil. This is of such great importance in India owing to the fact that vast areas are arid and dry, and very rainless, so that every small tree and every shrub that will grow on the rocky hill-sides is essential for the conservation of such water as does fall to the ground. All your lives you students will, therefore, be doing work that is for the direct and very great good of your country, and at the same time you will be enabled to spend your time out in the open, in the clean air of the forest, and close to Nature. Yet there is one great drawback to this profession; in spite of the obvious and great value of your work it is, and it will, I am afraid, continue to be, unpopular. This is the case in almost every country in the world; and it is not difficult, if you think about it, to understand why it is so; forests have to be preserved in the interests of *posterity,* that is to say, of the people who will live after we are dead, and this clashes continually, all the time, with the wishes and the interests of the present generation who would prefer to use them as they wish and without limit; were this permitted it would lead to their gradual destruction, with the result that floods would occur in the monsoons, covering the fields with sand and gravel, and allowing the water to run off and be wasted, instead of percolating gradually into the tanks and channels made to receive it; the fertility of the country-side would be spoilt, the grazing grounds would disappear and no fuel or small timber for house building and for making ploughs and other agricultural implements would be available; and eventually the local population would migrate to other parts where these disasters had not overtaken the country-side, and the villages would be deserted.

Again the forest officer's duty is to plant the timber supplies *of the future*, and this costs money in the present. The benefits to be derived from such planting are so far ahead, in the future, that people feel, very naturally, that it would be better to defer the expenditure for a few years as such delay will make little difference, they feel, in the end.

There are only two countries, that I know of, where forest control has been in existence so long that every thinking man recognises the benefits it confers and whole-heartedly supports the Forest Department. These two countries are France and Germany, whose forests have been protected and worked on correct lines for several hundred years. In North and South America, in Australia, in Ireland, forest control is resented and resisted.

The forests of India have been under control now for only some 70 to 80 years—very little in the life of a forest—but even so intelligent men in India have been realising for some years now that the forests are vital to their good, and I am glad to be able to say that the present Government of Madras very fully recognise this fact.

Without fear of contradiction, I can say that there is scarcely anybody who could pursue his ordinary avocation in life were it not for the presence of forests. The agriculturist depends *very* largely upon the produce he gets from the forest; grazing, small timber for house building, agricultural implements, fuel, etc., etc. The industrialist cannot exist without fuel to cook his food and without wood for a variety of purposes in an infinite variety of forms; wood, or some forest product, is used in every business that is pursued in the world to-day, and it always will be. Even, for instance the Stock and Share broker sits at a wooden table on a chair made of wood, and writes on paper made from wood pulp.

And now as regards the actual benefits that Madras has received from its forests, since their control was entrusted to a Forest Department, I would like to point out—what very few people realise—and that is that the Forest Department took over the forests of this country some 70 to 80 years ago, when they were in a deplorable condition. It is on record that there was no *timber* left in most of our big timber forests, and that none could grow to sufficient size to be worth exploiting for a great length of time; our fuel forests had been worked to exhaustion by the local population; all our accessible *bamboo* forests had similarly been over-exploited and had deteriorated greatly. It was the business of the new Forest Department,

when it was formed in the latter part of last century, to rehabilitate this ruined property, and it was naturally anticipated that to attain this end a great sum of money would have to be expended. And what has actually happened? The Forest Department of Madras has converted these ruined forests into a magnificent and exceedingly valuable property; the fuel forests have been preserved and improved so that the supplies of fuel now available are sufficient for the needs of the country.

And as for timber, the plantations already formed cover over 38,000 acres, and another 1,200 acres and more are being planted every year. The areas already planted have a value on maturity of over $5\frac{3}{4}$ crores of rupees net and some of them are already mature and are being cut every year, and replanted, and they are yielding over two lakhs of rupees net profit, per annum, and will continue to do so in perpetuity.

And what has this cost Government?

Nothing.

On the contrary, *all the improvements have been paid for out of revenue and the Forest Department has given to the Government in addition a net surplus of over four crores of rupees—three million pounds—in the time.*

Another fact that is appreciated by very, very few people is the enormous effect that the Forest Department has on *unemployment*. The figures are most striking. We employ, in a year, nearly two crores of men, women and children on productive works, and we distribute to them in wages nearly 50 lakhs of rupees.

Well, you students no doubt realise already that the profession you have chosen is a grand one, but you must remember that though forestry confers infinite benefits on the human race, there are very few of the human race that appreciate the fact, or like the process while it is in progress. You must, therefore, be prepared for opposition, and even for active hostility, and you must learn to meet it with sympathy and understanding; you must use as little harshness in the enforcement of the protection of your forests as you possibly can, but

nevertheless you *must preserve* your forests or you will fail in your high duty to your country.

And that, now, is all.

I must congratulate the Principal and the Staff on the progress of their work during the past year. From the results obtained the instruction has clearly been most efficient, since only two have been awarded the Lower Standard, and one student has earned the coveted "Honours" Certificate of the Madras Forest College.

I must close by thanking the Hon'ble the Prime Minister most heartily and most sincerely for presiding at this meeting to-day. He is a man who has more to do than most of you can possibly realise, he has little rest or leisure, and he has, as the Principal has pointed out, come all the way from Madras to be present at this Forest function to-day, and he has done this, certainly partly, in order to show to the country that he is in full sympathy with, and realises the vital importance of, the work that the Forest Department is doing."

In conclusion, the President, the Hon'ble Mr. C. Rajagopalachariar, Prime Minister of Madras, addressed the company as follows:

"MR. PRINCIPAL, CHIEF CONSERVATOR OF FORESTS, LADIES AND GENTLEMEN, AND SUCCESSFUL STUDENTS OF THIS COLLEGE,—

I wish—when I look at your faces eagerly looking forward to something interesting—that I had something to say, but it is very strange that I feel rather sad just now, and have not much to say. I feel like a conscientious hangman. I have come to an institution—I do not know whether the humorous intrigue of the Principal and the Chief Conservator of Forests has been responsible for it—I have been invited and I have come to an institution over which I have been responsible for a sentence of capital punishment. This institution, as has already been announced without much bitterness in the language of the Principal, is ready for abolition after a year. Mercy would have perhaps been exhibited if it had been abolished all at once, but this one year's time given to it gives added pain to all those who love the institution, and may I add myself to that list. I have been asked to preside and say

something pleasant on this occasion. Now I think you will understand why I felt as I said rather not fit at all for the function. However, I must say that I felt almost as if I forgot the doom of the College when I saw the bright young gentlemen receiving their certificates and their prizes in a style as if born to it. When I realise that they were only trained and carefully trained to it I can compliment those who were responsible for the training and the results announced show that the College has been doing very well indeed. And when I read the names and the full descriptions of the recipients of certificates given on the paper as I presented each one of them I noted that this was a cosmopolitan all-India institution that has been bringing year after year students from various parts of the country. It seems, as if therefore there is something in this College in Coimbatore, that people from Indore, from the Punjab, from Ceylon and from other distant places could come and spend two or three years here of valuable time during the best period of their lives. There is something in the College which brought them together and it is a pity that we have to close it down. I say so quite sincerely. In fact, I might share with you now the truth that at the time when I signed the paper for closure of the College, I did feel a great compunction as I generally do not feel with regard to other kinds of retrenchment. I asked a question again of my colleague, 'Is this to be' before I put it down. Well, let us hope for the best still. I do not say that the decision will be reconsidered because it is no good reconsidering decisions once come to. But forestry is a perpetual thing, a great and precious thing. The forests of our country are our greatest assets. I was of that opinion even before I heard the brilliant speech of the Chief Conservator of Forests. A College which is brought up for the purpose of maintaining that valuable possession of the whole country is a great institution which could be revived at any time if we have the facilities and the resources for it. There is nothing lost by a temporary decision of this kind as all decisions of the world must be deemed temporary.

The young gentlemen who took away the certificates and prizes are perhaps some of the best of the young men of our

country and I join with you both, Mr. Principal and the Chief Conservator, in wishing them the best career in the service of the country in this department. Very good advice was given by the Chief Conservator. You have reason, young gentlemen, to be proud of the profession that you have chosen and whether you immediately get jobs or not you belong to that profession and you must retain those ideas and learning that you have acquired here.

The sports prizes particularly charmed me. I was rather sorry that non-Madrasis were taking them all away. But I was pleased when Olimuthu came to the rescue from Tinnevelly and took away some of the best prizes (cheers.) Not that I grudge other parts of India at all. But it is a little more pleasant if it is one's neighbour. Let us hope that the young men of our own province will take away more of the prizes in such institutions where people from all parts of the country have a chance to compete.

The song of the forests was sung by Mr. Wilson and very truly. A man cannot rise to heights of poetry unless there is truth at the bottom of it. These forests he claims were entirely lost or all but lost till 70 years ago and then the Department came and reclaimed them. I have not read the history of the forests. If it is true that they were all but lost at that time and that they had been brought back to existence with care by the Department, indeed you can be proud of the administration of the Department. I have always realised that forests are perhaps our best and most valuable possession, more valuable than what is hidden below even in the shape of gold. It is not necessary to prove the case. The indigenous culture of our country holds the vegetable world in very great esteem and value. It is considered as great a sin to cut down a green tree as to chop a man down. It is considered murder according to the religion of our land to cut down a live tree. And old-fashioned men even in these days hesitate to cut down a green tree. I wish that culture had not been interfered with by other ideas and that people retained towards forests the same sacred feeling as they would retain towards a body of living men. They would not then carry an axe there and cut it off for a

temporary small purpose. But for various causes this idea of the sanctity of vegetable life has been upset and exigencies of life in and around forests have driven these poor people who live there to go up and steal the permanent asset of our country away in this manner that has been described, and valuable property has been lost. It is good that the people have come to be told; "better late than never" and that these things must be conserved. And the extraordinarily convincing propagandist story that has been told by Mr. Wilson is very interesting, especially the finance part of it. It is a fact that great work has been done by the conservation of the Forest Department and that it should be better recognised. It will be recognised, I assure you, sir. You are right in saying and I am one with you in appreciating the philosophy of forestry and the actual need for the Forest Department in the country. I do not share the peasant's feeling who, in order to make a couple of annas which he needs very badly—of course, he is also a living tree—becomes a temporary parasite of the jungle for the moment and he goes and steals away the wood to make those two annas. However, let me assure you that he knows it is wrong not because of the Department but because he knows it is wrong to cut down a living tree. It is a very good thing that you have reiterated it, however. I think in course of time these things will become more appreciated. You seem inclined to resign yourself to a philosophy of despair. This Department will not be unpopular. In course of time it will become popular; because truth must triumph. If we really preserve our sanity, if we really understand our own good, we are bound to understand the value of these things. But I hope in your admiration for the tree you will not lose your consideration for the man. You have to keep both the plants.

Reading the ancient literature of the land where forests have been described, who can take an axe and cut down a tree? If you read the Ramayana of Valmiki, even Rama is not so grand as the forest itself. Certain things have happened which seem to have confused the people. I think some bad examples have been placed before the country. Large tracts of forest have been spoiled by the government deliberately and people

say, "Well, look at the tea and coffee plantations that have risen here and there" and they have lost the sense of respect for the tree to some extent on account of these things, and then ideas got all wrong, and now a belated conservation makes people hesitate to accept doctrines which are perfectly true but which are advanced belatedly. These are difficulties. We must renovate the ideas of the people with regard to these things. People accept things even without proper examination. Even in these days people believe in all sorts of new things. Not only all forests are necessary for agriculture but even thunder and lightning are necessary. People do not hesitate to receive new truths. Therefore, let us not be sad over the unpopularity of forestry. In course of time, it will be quite popular.

We must do some new things. I hope I am not trespassing on the domains of my colleague, Mr. V. I. Muniswami Pillai, if I dream on this occasion that perhaps you will discover one day how to plant new trees and then it may be quite easy to allow even the peasant to cut a few pieces of wood which he desires, here and there, without great danger to the forests as a whole. There are many, many hills with nothing on them. I wish we could discover some "hair-restorer" for these. I wish he would devise some kind of cannon by which he could shoot specially strengthened seeds and spread them over the top of the hills at particularly chosen seasons so that they might thrive and live for ever and make the places hills once again where there are merely bald rocks now. That is a dream which often passes through my head when I look at these beautiful hills of ours in the south which have been once fertile, but only bones in the shapes of rocks remain now. It is possible for the Forest Department to bring up beautiful forests on some of these rocks.

These abolitions and retrenchments go against my heart, but I do it simply out of the coercion of facts. If you give me at least the benefit of that sincere feeling, I shall be content."—*The Madras Forest College Magazine*, Vol. XXIII, June-December 1938.

The following information is taken from the accounts relating to the *Seaborne Trade and Navigation of British India* for April 1939:

IMPORTS

ARTICLES	MONTH OF APRIL					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	285	258	..	32,269	31,046	..
French Indo-China	533	499	505	57,823	55,893	54,240
Burma ..	14,350	12,243	11,341	17,73,792	17,41,977	14,70,281
Java ..	194	107	519	26,005	7,521	55,312
Other countries ..	352	..	..	35,623	..	..
Total ..	15,714	13,107	12,365	19,25,512	18,36,437	15,79,833
Other than Teak—						
Softwoods ..	1,528	2,318	1,668	97,365	1,82,307	1,17,109
Matchwoods ..	1,101	744	1,350	71,442	45,734	1,01,787
Unspecified (value)	..	..	..	2,02,000	3,06,999	1,82,042
Firewood ..	36	62	27	539	924	405
Sandalwood ..	15	7	5	1,651	684	959
Total ..	2,680	3,131	3,050	3,72,997	5,36,648	4,02,302
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No	data	No	data	
Sleepers of wood ..	..	59	52	..	10,431	6,122
Plywood (tons) ..	756	570	421	1,69,972	1,25,676	91,586
Other manufactures of wood (value) ..	..	..	..	1,77,716	1,55,884	1,34,427
Total ..	756	629	473	3,47,688	2,91,991	2,32,135
Total value of Wood and Timber ..	..	..	..	26,46,197	26,65,076	22,14,270
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	17,426	25,841	16,781	1,31,801	2,50,745	1,73,047

EXPORTS

ARTICLES	MONTH OF APRIL					
	QUANTITY (CUBIC TONS)			VALUE (RUPEES)		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	22	..	10	2,812	..	1,250
,, Germany ..	..	1	..	..	150	..
,, Iraq ..	44	55	8	8,632	18,227	2,226
,, Ceylon ..	..	..	..	..	59	..
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	50	124	280	9,705	27,597	37,290
Total ..	116	180	298	21,149	46,033	40,766
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	3	..	..	840	..	..
Unspecified (value)	..	..	..	1,67,158	25,770	16,362
Firewood ..	115	..	..	1,027	..	..
Total value ..	118	..	..	1,69,025	25,770	16,362
Sandalwood—						
To United Kingdom	1	..	..	800	..	..
,, Japan ..	1	2	30	600	1,823	31,030
,, United States of America ..	60	75	5	58,040	80,000	5,000
,, Other countries	36	13	32	37,707	14,987	34,597
Total ..	98	90	67	97,147	96,810	70,627
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	11,385	17,100	33,960
Total value of Wood and Timber ..	..	..	..	2,98,706	1,85,713	1,61,715
Other Products of Wood and Timber		No	data	No	data	

INDIAN FORESTER

AUGUST 1939

FORESTRY BEYOND THE INDUS—IV

By H. L. Wright, I.F.S.

IV.—THE GILGIT FORESTS

"Forty-one years of consideration; four months and ten days of field work; the mysterious interlude of a Mr. Steane and finally a working plan by a ranger, sent to this Agency without maps and for information, three years after it was completed." In these words the late Political Agent, when asking the Government of India to send a forest officer to inspect and advise on the forests of the Agency, summed up what he called the melancholy and almost incredible story of forest conservancy in Gilgit.

Gilgit is territorially part of Kashmir and until recently was administered as such by Kashmir officials. In those days the forests were no man's child. The jurisdiction of the State Forest Department did not extend to Gilgit, and the forests were nominally in charge of the head of the revenue district, who in Kashmir is known as the Wazir. The Political Agent had only advisory powers where internal administration was concerned, and probably the last word regarding forest management came from the Kashmir garrison, who as the biggest user of the forests, from which they obtained their firewood, naturally expected to have some say in the matter when it was decided which areas were to be felled.

This explained "the mysterious interlude of a Mr. Steane," now Conservator of Forests, Tasmania, who was for many years an officer of the Kashmir Forest Service. Being in Gilgit during the war as an I. A. R. O. officer attached to the Kashmir Artillery, he worked out a scheme to regularise the supply of firewood to the garrison. This appears to have been followed for a time, but as the annual coupe became further away it was conveniently forgotten.

In 1921, however, the Kashmir Government, at the request of the Residency, sent a trained forest ranger to Gilgit to inspect the forests and to prepare a simple scheme for their management. The man selected, Raja Mahbub Wali Khan, was particularly well suited, being the one and only trained forest officer that Gilgit had produced. Knowing the country intimately and its people, he could understand what was required and could appreciate the difficulties that would confront any attempt to tighten up forest control.

He produced a useful report, which was accompanied by a rough stock map and a detailed description of the forests. His main proposals were the employment of a small establishment for protection and of a trained forest ranger to assist the Wazir and largely to relieve him of forest work; the revision of the existing forest rules; the stopping of unrestricted felling; management under the selection system, with definite areas allotted each year for working; the restriction of dangerous usages; the improvement of overfelled areas by artificial work, and the extension of willow planting to augment the fuel supply.

The report was submitted to His Highness the Maharaja, who ordered that it should be treated as a working plan and enforced as such, and as a preliminary to sending a forest ranger to Gilgit, revised forest rules were issued in 1932, delegating some of the powers of the Wazir to the ranger. But for various reasons no ranger could be spared from the Kashmir service, and as this was the first essential, none of the other proposals could be carried out and the report became no more than a document of historic interest.

This was the position when about three years ago the country beyond the Indus was handed over to the Government of India to administer. Kashmir sovereignty remains and Kashmir laws are still in force, but all Kashmir troops and officials were withdrawn and the country is administered by British Indian officials and garrisoned by a local corps of Scouts, with officers lent from the Indian Army.

As constituted at present the Gilgit Agency consists of:

(*i*) The Gilgit Sub-division, which is the trans-Indus part of the former Kashmir district or wazarat. This is directly administered by the Political Agent, with an assistant political agent in executive charge;

THE GILGIT FORESTS

Photo : H. L. Wright (Copyright)

The upper reaches of the Naltar river with birch, willow, poplar and mountain ash.

Photo : H. L. Wright (Copyright)

THE GILGIT FORESTS

The Naltar Valley near Naltar, the summer residence of the Political Agent.

(*ii*) the States of Hunza and Naggar;

(*iii*) the political *ilaqas* of Puniyal, Yasin, etc., each under a locally appointed Governor, the Governor of Puniyal being the hereditary *jagirdar;*

(*iv*) Chilas, a collection of village republics lying on both banks of the Indus below Gilgit, under the control of the Political Agent, who is assisted as assistant political agent by one of the officers of the Gilgit Scouts, who also commands the detachment at Chilas.

The Political Agent also exercises rather a nebulous political control over Darel and Tangir, two independent tracts lying north of the Indus between Gilgit and Chitral.

Only the forests in the Gilgit Sub-division come under the direct control of the Political Agent, and Major Kirkbride, who was Agent at the time of the transfer was quick to realise how important it was to bring these under some form of management. He asked, therefore, for a forest officer to be sent to Gilgit for two working seasons to make a thorough inspection of the forests in the Agency and to prepare a working plan for them. This proposal was not accepted; instead I was sent to Gilgit for two months to see as much as I could in the time and to advise on future management.

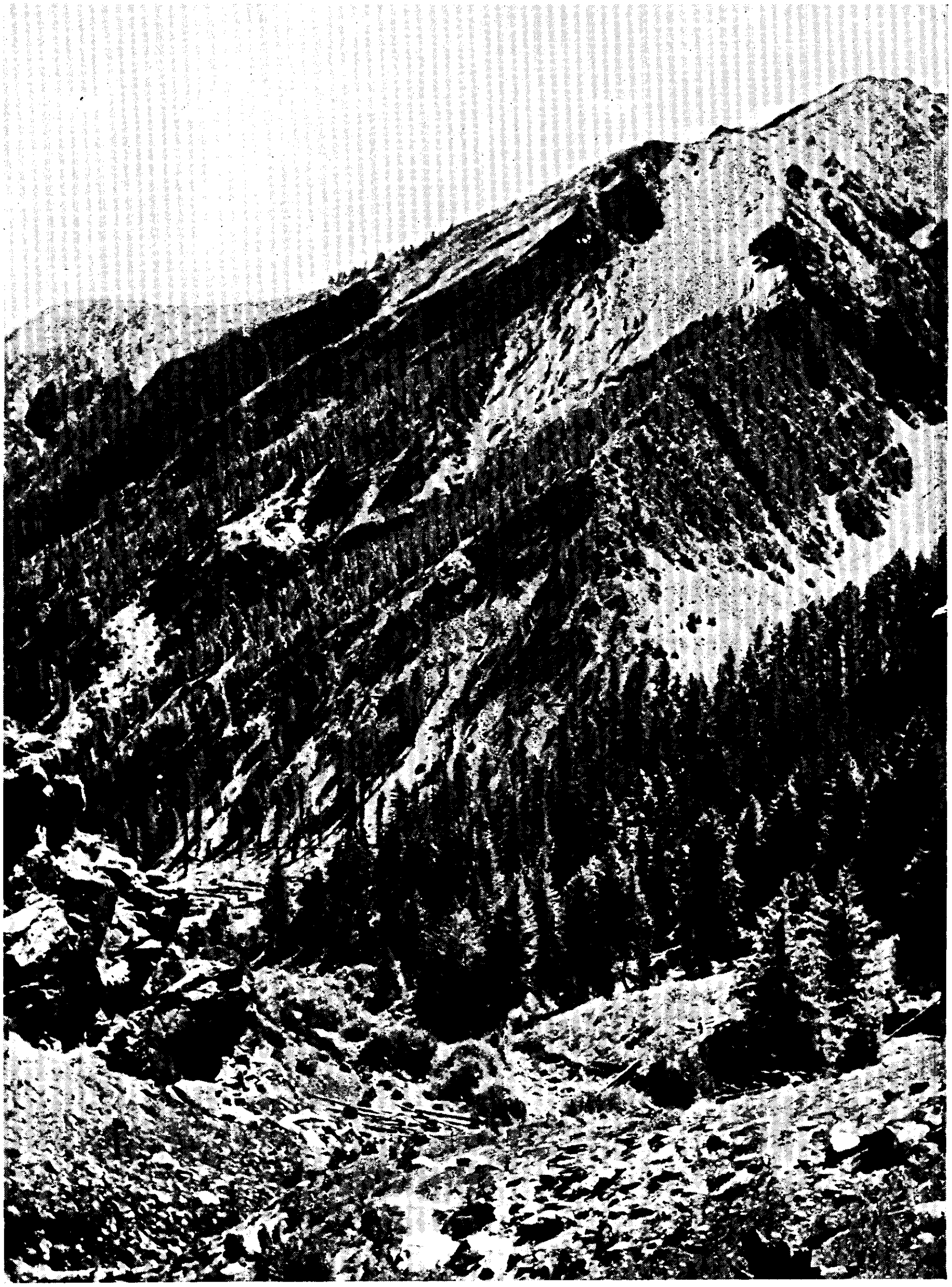
Leaving Abbottabad in the middle of August 1937 I marched to the head of the Kagan Valley, crossing from the North-West Frontier Province into the Gilgit Agency by the Babusar Pass (13,400 feet), and from here went through Chilas to Gilgit by the Indus Valley route. Never in the whole of my service have I struck quite such bad country as during this part of the march, as even at the end of August there are few places more typical of one's early ideas of Hell than this part of the Indus Valley. But it had its compensations. One was the unforgettable view of Nanga Parbat, rising straight up from the Indus, a sheer vertical rise of nearly five miles; another was the enormous dish of grapes brought in by the *chaukidar* at Talliche after a very long and thirsty march.

Gilgit itself was delightful, a long, narrow oasis, where with ample irrigation everything seems to grow. I was able to spend just under four weeks in the sub-division, and during this time saw the two most important forest *nullahs*, the Naltar and Kargah, and so

obtained a very fair idea of the forest resources of the Agency. The journey back was made by the better known route through Astor, crossing the Burzil Pass (13,700 feet) to Srinagar, and on this part of the journey it was not the heat we suffered from but the cold, as by the middle of October winter had already set in on the passes. The total distance covered during these two months was just over 800 miles, which included a complete circuit of Nanga Parbat, which earlier in the year had taken such heavy toll from the German climbing expedition.

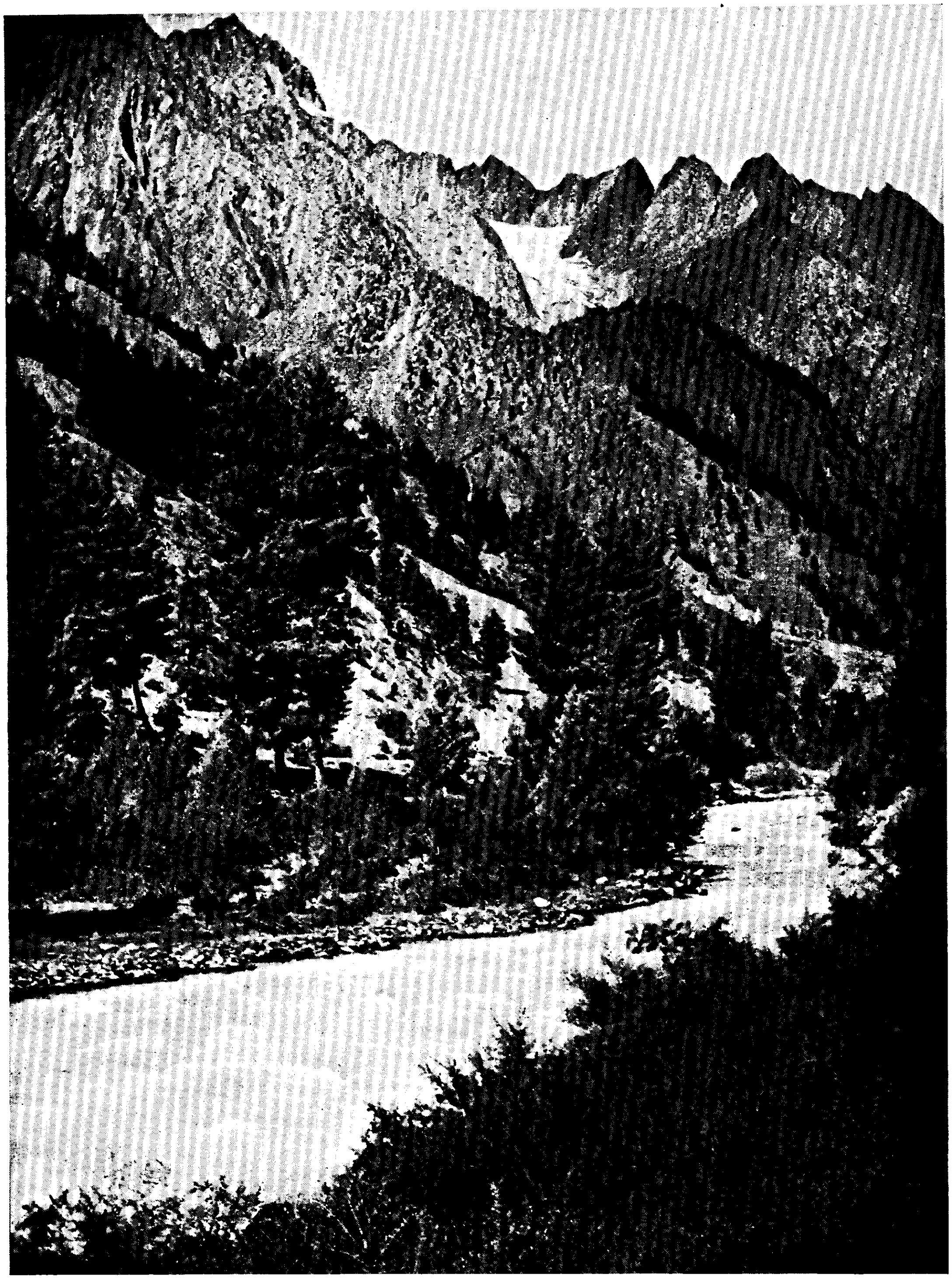
The main feature of the Gilgit forests, of which the chief economic species are the spruce and the blue pine, is the high elevation at which they grow, there being little except scattered juniper and *chilgoza* below 9,000 feet. At this elevation spruce grows practically pure, and above this are patches of blue pine which seems gradually to be spreading downwards. At this elevation the trees are slow growing and much damage is done by avalanches. Snow-breaks are frequent and the *nullahs* are full of dead wood. Fires are another source of damage and are the cause of the many dead trees standing in the forests. Usually of small extent, these fires appear to have been started either intentionally or accidentally by the *Gujars* who use these forests. The cutting of small poles for roof timbers and bed frames is another dangerous practice, especially as nowhere is regeneration at all profuse. Above the conifers are stretches of birch and other broad-leaved species such as willow, poplar and mountain ash, and nowhere have I seen a more delightful mixture of species than where the conifer and broad-leaved zones just overlap.

Over the whole sub-division the percentage of tree-clad land is very small; nowhere are the forests extensive and many of them are mere pockets of trees growing high up on the mountains and almost inaccessible. The Gilgit forests never have had and never can have any commercial importance, and in a country with an annual rainfall of from five to six inches any extensive schemes of afforestation are out of the question. But it is the smallness of the forest resources that makes conservation so important, and there is no reason why, with careful protection and management, these forests should not continue indefinitely to serve their main purpose, that of meeting local requirements of both timber and firewood,



THE GILGIT FORESTS *Photo : H. L. Wright (Copyright)*

Mixed conifer (deodar, spruce & blue pine) near Babusar, the summer headquarters of the Assistant Political Agent, Chilas. (Although in the Gilgit Agency, this is not actually trans-Indus).



THE GILGIT FORESTS *Photo : H. L. Wright (Copyright)*

Looking up the Naltar valley showing how poor the stocking is in most places in Gilgit.

In most of the forests all that is necessary is to enforce the existing law to stop illicit fellings, particularly of small trees, and burning, but provided there is no large influx of graziers from outside places like Tangir and Darel, there appears no need to restrict grazing, except in places definitely taken up for cultural operations. The main drain on the forests is the Gilgit fuel supply. This is estimated at 20,000 maunds per annum; not a large quantity, but it needs organising unless the more accessible forests are to be gradually destroyed. There is, however, so much dead wood lying in the *nullahs*, and so many dead trees standing in the forests, that all that seems necessary for a number of years to come is to allot a definite area for dead wood working each year, to insist on the contractor working nowhere else and to see that he cuts no green trees.

Everything thus comes back to the first recommendation of the 1929 report, the urgent need for a small forest establishment, particularly of a trained forest ranger, who, working under the assistant political agent, could be made responsible for the whole of the forest work in the Agency. With such an establishment it would be possible not only to protect the existing forests, but also to undertake cultural works on a small scale on some of the more suitable places in the overworked areas, and at the same time much could be done at the lower elevations, below the forests, in places like Gilgit itself. Here, wherever there is irrigation, willows and other trees grow extremely well, and a great deal could be done to improve both the amenities and the tree wealth of the Agency, by having a well-considered scheme of arboriculture carefully carried out and supervised by a trained forest officer.

THE MOST PAYING ROTATION IN INDIAN FORESTRY

BY W. E. HILEY

Mr. Laurie has very kindly sent me an advance copy of his article in the *Indian Forester* and, as he has expressed strong disagreement with some of the views which I published nine years ago in *Economics of Forestry*, he has invited me to reply. I have read the article with very great interest and although I naturally

dissent from much that it contains, I sincerely welcome its publication. It challenges us to examine our deeper intentions and the motives behind them and it is right that we should spare time for this from the bustle of day-to-day management.

Since writing the book referred to, I have spent most of my time in the practical management of woods. This has necessarily modified and, I hope, broadened my outlook, and has made me much more conscious of the reasons why practical foresters are often unable—and indeed unwilling—to follow exactly the rules and precepts which are derived from theory and calculation. In the long-fought battle between silviculturists and economists about the length of rotation, many of the silviculturists have been guilty of errors in economics and many of the economists have shewn ignorance of silvicultural needs and administrative difficulties and—what is more important—have over-estimated the importance of finance as a factor in determining policy.

Let us first get our financial ideas straightened out. Compound interest is not an invention of forest theorists but a fundamental concept of economics; a bill which has to be paid ten years hence is not the same as a bill for the same amount which has to be paid now, and the difference in the obligation can only be expressed on a discount basis. The delay of ten years in paying the bill gives us the free use of the capital in the interval and, if wisely used, this capital will be earning wealth.

Let us take a forest example. An owner has a plantation 60 years old which he can cut now, or he can leave it to grow to 120 years old when it will fetch three times as much. If he sells the timber now he may invest the proceeds in buying and planting up four times the area and sixty years hence he may obtain four times as much money. Or, he may invest the money in building a road, railway or sawmill which will increase the value of the remaining timber and thus earn a greater income. Capital is always needed for development; if this were not so, people would not pay interest on it. And this is why it is always bad finance to keep capital locked up in growing stock if it is not earning a fair return. Mr. Laurie confuses the issue by regarding an investment only as

the money which has been spent in buying or growing timber for this is a very restricted point of view; the investment may equally be regarded as the capital retained or created in the forest, the value of the land and standing timber and the prospective value of immature trees. All this capital is locked up in the forest and the question at issue is: When and at what rate should it be realised?

I now come into definite conflict with Mr. Laurie for I steadfastly maintain that the financial rotation is, with certain minor qualifications, that which yields the highest rate of compound interest on the investment or—what comes to the same thing—the highest rate of simple interest on the capital value of a normal forest. If, however, the maximum financial yield is higher than the rate of interest which can be obtained on other equally secure investments, whether in the forest or outside, then a financially minded forester would prolong the rotation to such an extent that the rate of interest in the forest fell to the competitive rate.

On pages 173 to 175 of my *Economic of Forestry,* I shewed that for each increase of 10 years in the rotation in a normal forest of given area and type, there is an increase in the capital value of standing timber. There is also, up to the rotation of highest income, an increase in the net income. But as the rotation is prolonged, each additional dose of capital yields a smaller and smaller dose of income until, when the rotation of highest income is reached, the last dose of additional capital yields no additional income at all. So, if we adopt the rotation of highest income, we are retaining capital in our business which yields no income, a system which "has no financial attractiveness." This seems to me so clear that I cannot see why any one should regard the rotation of highest income as that which is financially most attractive.

Mr. Laurie refers to Chapman's support of the rotation of highest income in his *Forest Finance* (1926). It is noteworthy that by 1931, when he published the second edition of this book, he had changed his point of view and no longer advocated a rotation of this nature.

On this fundamental issue—what is the financial rotation?—I hold firmly to my published opinion and cannot agree with Mr. Laurie. I must admit, however, that the calculated financial

rotations are nearly always too short for practical use. There are many reasons for this which I will put under two heads:

(*i*) *The calculations are generally erroneous.*—The chief source of error is that calculations are based on money yield tables in which current prices for various sizes of trees are introduced. But if large areas were managed on shorter rotations than at present there would be a glut of small size timber and the price of such timber would probably fall. The financial rotation based on these new prices would then prove to be longer than before.

Another error arises from the difficulty of ascertaining costs of operations and of management. Published costs are nearly always lower than the average, and any increase in cost will lower the maximum rate of interest that can be earned and will lengthen the financial rotation.

(*ii*) *In general, rotations should be longer than the financial rotation.*—It will usually be found that if the rotation is prolonged, even by decades, beyond the financial rotation, the reduction in the rate of interest is not so great as to be very material. So, if other advantages are gained, they may outweigh the disadvantages.

Now, unless the object of the management is to produce a particular size such as pitprops, there are very distinct advantages in a moderately long rotation:

(*a*) They enable a reserve of timber to be built up which can be realised in time of need or when the market is favourable.

(*b*) Up to a point they favour natural regeneration, though it is not worth while to wait too long for this. They do in general make management more elastic.

(c) In so far as they are good for the soil, this would be a very strong argument in their favour. There is, however, little conclusive evidence that they are good for the soil.

(*d*) In such countries as Britain it is a matter of national importance to keep a large stock of timber in the country.

(*e*) In practice the most influential reason for long rotations is the satisfaction that big trees give to the forester, as well as the general public. The forester should be proud of his craft and, though his attitude may be at bottom sentimental, it is none-the-less real, and men do better work if their healthy desires find satisfaction.

My attitude to Mr. Laurie's paper may be summed up as follows. I do not think he has the right idea about financial rotations though I admit that he is justified in preferring rotations that are longer than are justified by purely financial considerations. The rotation of highest income is nearly always too long and there is no scientific reason for adopting it.

I have a hope that in unevenaged woods the financial rotation may prove to be longer than in evenaged woods;, but until we have more reliable yield tables for unevenaged woods it is impossible to tell.

FINANCIAL ROTATION VERSUS ROTATION OF HIGHEST INCOME

By C. M. Harlow, I.F.S.

Summary.—Mr. Laurie's argument is that the rotation of highest income will ultimately give a much bigger income than the financial rotation. In comparing them the time factor can be ignored. The answer is that in practical politics current income must loom large, and therefore the time factor cannot be ignored. Once the time factor is introduced, the two cases must be presented mathematically, and the rotation of highest income will lose to the financial rotation.

Many of us have no doubt read Mr. Laurie's note on rotations with great interest. In my case the interest has been coupled with a certain amount of surprise, presumably because I am not so abreast with current thought on the subject as Mr. Laurie is. Except for Schlich I do not think I have read the authorities mentioned and I hardly remember the correspondence referred to in the *Indian Forester*. I am unable to look them up at the moment for various

reasons. Most of us learnt our forestry from Schlich and his successors, and though I remember him filling his blackboard with one after another of his colossal formulæ, yet I distinctly remember that he impressed on me that this was theoretical forestry, and that it must be kept in its proper perspective when applying it practically in a working plan. Mr. Laurie obviously wishes to consider the matter from the practical point of view, so that we start off on common ground. Before dealing with the subject-matter of the note there are a few special matters to which I wish to refer.

Rotation.—This is supposed to be the age to which we grow the woods in our forest. Except in forests managed on quite low rotations it must be seldom that main fellings are carried out at this average age. During my training in Germany I can hardly remember felling any wood of which the average age was exactly that of the rotation prescribed in the working plan; no doubt it does occur sometimes but this will be in the nature of an accident. Working plans are revised about every ten years, and during periods of the order of a hundred years and more there is plenty of time for ideas to change, and plenty of time for the factors and facts to change on which the rotations are calculated. For forests grown to great ages, the rotation is really only a theoretical figure, calculated on facts at the time the working plan is prepared, and used in that working plan for calculating the yield during the next ten years or so.

Price increment.—This item has probably given all working plans officers a considerable amount of trouble, and Mr. Laurie clearly recognises this great difficulty. I can perhaps make my difficulties clearer by example than by anything else. The teak forests of Hoshangabad and neighbouring districts find their consuming market for the larger timber in Bombay Presidency (North Central) and in parts of Central India, the United Provinces and even the Punjab. The timber is mostly taken out by departmental agency to sale depots on the railway and is there auctioned. The small timber is sold in the round, rough dressed, by girth classes of about three inches from nine inches upwards. Thus the lowest class is nine to twelve inches girth, the next 12 to 15 inches and so on. Large timber is sold "rough squared" but the squaring is extremely well done. The classes are known by names such as *charpat, miyal* and *nat,* but for practical purposes one may say that the squares are sold

by the size of the side of the square thus six to nine inches, nine to 12 inches and upwards. As a general rule, a tree of two feet nine inches breast-height girth and over can be rough squared. When we come to consider prices we find that our smallest size of round timber nine to twelve inches really gives the best price per cubic foot. In the neighbouring Nimar Division some poles six to nine inches are exploited departmentally and fetch even better prices. When we get to higher sizes of round timber we find the prices per cubic foot decrease, until we get to round timber two feet to two feet nine inches in girth which is our class most difficult to sell, so that the tendency now is to saw it up in the forest into stock-sawn timber sizes. It is true that we can occasionally get very good prices for first-class round timber of this size for use as transmission poles, but neither the demand nor the quality of our timber is anything like that desirable. If we could rely on the prices mentioned above we should reach the ridiculous conclusion that it would pay us best to grow our Hoshangabad teak on a rotation of about ten or fifteen years to produce dressed poles of 9 to 12 inches girth which yield the best financial results. The conclusion I wish to draw is that in considering price increment and its effect on rotations, we must consider the quantity of each class of material that we are now putting on the market, and compare it with what the market wants, and realise that increased quantities of any particular commodity will depress the market for that particular commodity. In regard to our round timber the truth is that the local market and the markets in adjoining parts of Bombay need large quantities of 9 to 12 inches and 12 to 15 inches round timber for use in ordinary local huts and small houses. Our present fellings do not produce large quantities of these sizes and prices are consequently up. The hut of the ordinary Indian villager and poor townsman seldom needs timber of the larger round sizes, and as industry has little use for it either, its prices are poor. Our teak forests, especially the coppice forests on rotations of 30 and 40 years produce quantities of larger sized round timber and the natural inference is that these rotations are too big or too small. Turning to squared timber we find that the general type of Hoshangabad forests produce large quantities of *"charpats,"* or six to nine inches squares, much smaller quantities of *"miyals"* 9 to 12 inches squares, and exceedingly few *"nats"* or squares of over 12 inches.

The forests of Bori are better quality and produce a distinctly larger proportion of *miyals* and *nats*, but nevertheless the bulk of its squared timber is in the form of the smaller sized squares. The markets at present show a decided liking for the big sizes and as the supply is small the prices are really high, and the price increment curve for our squares is really steep. I am the first to admit that there must certainly always be a decided price increment in timber derived from trees of 3 feet upwards in girth, but when the proportion of trees of the larger girths put on the market becomes higher we must be prepared for the fact that the price increment curve will become somewhat flatter. How much flatter is of course the question which we are unable to answer, but it is the crux of the problem in fixing rotations. It is the real reason why our working plans officers have so frequently fought shy of the question of price increment. Even in forests which have reached the condition referred to by Mr. Laurie as "static," we can accurately calculate price increment to-day, but we have not the slightest idea what it will be 100 years hence; this point is, however, not difficult, and in such "static" forests I agree we must try to apply to-day the price increments ruling at the time.

In spite of his somewhat ambiguous title, Mr. Laurie has clearly defined the issue he is discussing to be between the financial rotation and the rotation of highest net income. He desires to rule out of discussion the mystic symbol $1.OP^n$ and as far as possible I shall try to concede this condition, though I must admit in the end the condition cannot be complied with. To quote from Mr. Laurie;—"Should our forests in India be worked to produce the maximum net annual revenue regardless of the rate of interest this represents on the forest capital, or should they be worked so as to produce the highest rate of interest on the forest capital regardless of the *reduction in total revenue that this involves*." The italics are mine, and it is to this phrase that I particularly wish to refer. Some figures are then quoted from Schwappach's money yield table which will suit my purpose as well as any other.

I. *Financial rotation*.—Annual yield 2,950 marks per annum
Rotation 40 years.
Interest 4.45 per cent.

II. *Highest income*.—Annual yield 6,240 marks per annum.
Rotation 140 years.
Interest 3.55 per cent.

We will suppose that the Chief Conservator of Forests has to consult the Minister on forest policy and he goes armed with these figures to say "Which do you want?" The answer will be "Number II please and with effect from the first of April if not earlier." The Chief Conservator of Forests will then have to explain that it is not quite so simple as this. There are at least two possible cases, perhaps I should say three, and to explain I must say that I take Mr. Laurie's term "static forest" to mean what I learnt to call a normal forest, *i.e.*, something like a normal series of age gradations for an approved rotation. If the forest dealt with has been managed in the past on the rotation of highest income and is now static, the Chief Conservator of Forests would say that all we have to do is to continue the present system. I should hesitate very much before I stressed the fact to the Minister that the effect of a change-over would be to give a much larger income for a number of years, probably 14,000 marks per annum gradually decreasing year by year for about 40 years until we became static again at the financial rotation and the fixed income of 2,950 marks. This is the only concession that I can make to the rotation of highest income, namely, that the static forest for that rotation exists (or something near it) at the time the decision has to be made. This condition exists nowhere in the Central Provinces.

Now let us take the other alternative, that we have the static forest required for the financial rotation. The Chief Conservator of Forests will have to explain to the Minister that we cannot unfortunately bring the new policy of the rotation of highest income into full force from the 1st April. In fact from the first of April we shall have to reduce our income to about two-sevenths of the past income, *i.e.*, to 843 marks during next year, but the following year this will increase a bit and it will go on increasing until in the year 100 from now we will give you the sum of 6,240 marks per annum in perpetuity. Mr. Laurie's argument appears to me to be that this time factor of "100 years hence" does not matter in the least, in fact we must ignore it and compare an income of 2,950 marks beginning now and continuing for ever, not with a much smaller income beginning now, and slowly increasing to 2,950 about 40 years hence and continuing to increase thence to 6,240 marks a hundred years from now, but directly with the 6,240 marks to be obtained 100 years

hence. If he puts this proposition to the ordinary Minister the answer will be: "Give me the 2,950 marks now and for ever." The Chief Conservator of Forests may be lucky and find not only a Minister, but a statesman with the long view. Such a Minister will hesitate and say: "Yes, 6,240 marks sounds attractive 100 years hence, but so does 2,950 marks against 840 at the present day. What do the expert forest officers advise?" The answer must be that the expert forest officers are divided into Lauries and Harlows with perhaps some sitting on the fence. The Minister will consult his economists who will surely say "Consult the actuaries." I am sorry about this but unfortunately the actuaries will at once bring in that dreadful expression $1.OP^{n}$, and there I fear the matter will rest.

The third case to which I refer is the case when the forest is sub-normal by which I mean that the volume of the growing stock is below that which would represent the normal series of age gradations for a forest worked on the financial rotation. The bulk of the teak forests of the Central Provinces are in this state, a fact which can easily be proved by comparing the outturn we now get with the outturn shown from the poorest quality teak forests in the Nilambur yield tables. The present management has been dictated by an attempt to work up to a volume of growing stock representing the normal forest for what we conceive to be the financial rotation. At the best we may achieve something like this in 60 or 80 years. This means that at present we are cutting a yield considerably below the annual increment. If the ideal to which we should aim must be the growing stock representing the normal forest for the rotation of highest income, our yield must be still further reduced below the current increment, in order to pile up the much larger capital in the form of a much larger growing stock required by the rotation of highest income. The argument is thus really exactly the same as that developed in paragraph 6, and is not really a third case. The point is that if we are satisfied with the financial rotation we can continue to take something like our present yield; if we are to aim at the rotation of the highest income we must at once cut down our yield considerably.

Mr. Laurie has developed his argument with considerable ingenuity, but I fear he has been guilty of several basic errors of omission. He states that the whole point is that once the forest has

reached any static condition, *the time element is eliminated.* This is true only when the rotation is fixed and unalterable. As a general statement it is untrue. Assume a forest that consists of a normal series of age gradations for the financial rotation. If we decide to change over to the rotation of highest income, we must at once cut down our yield for a considerable number of years in order to pile up the growing stock until it reaches the size required for that rotation. If this action is not introducing new capital by deducting an annual sum from income, what is it? Later on we are asked: "What then is the financial object of managing the state forests in India?" The answer we are given by Mr. Laurie is: "Surely they should be managed on behalf of the tax-payer as one of the sources of revenue for the state." Mr. Laurie's method is to reduce the benefits to be derived by the present tax-payer in order to give the great-grandchildren of the present tax-payer something really substantial. Is the present tax-payer going to stand for that? I fancy that he will demand his fair share of the benefit, and that is what the advocates of the financial rotation propose to give him. For the purpose of his arguments, Mr. Laurie always assumes that he has got the static condition corresponding to the rotation of highest income, whereas in the Central Provinces the reverse is always the case, and I am sure we have not yet got anywhere near the static condition corresponding to the financial rotation. I find that I have done Mr. Laurie some injustice by stating that he ignores the fact that his "improvement of the forest finances" involves putting back some of the revenue into capital; but he also admits that this immediately introduces the time element which he is so anxious to ignore.

CHIR IN CHANDARS

BY S. H. HOWARD, I.F.S.

[*"Chandars" are grassy open areas in sal forests often extending over hundreds of acres, maintained in that state through fire, frost or water-logging, possibly of artificial origin and frequently covered with tall, coarse grasses.*—EDITOR.]

There are two sorts of *chandars, sal chandars* and non-*sal chandars.*

I am not dealing here with non-*sal chandars*. They are a separate problem entirely, many of them being under water for weeks on end during the rains. *Chandars* are called *phantas* in North Kheri.

Early in May the *sal chandars* are a beautiful sight. Thousands of acres of apparently young *sal*, mostly four to six feet high, are densely stocked and seemingly healthy. Passers-by in the train have been known to point out this magnificent work of the Forest Department in raising these fine young crops. But, alas! practically every winter they are killed to the ground by frost and, though an occasional area gets through, *e.g.*, a fringe down the Sarda Canal, they have been like this for at least 60 years, and goodness knows how much longer.

Yet, potentially, here are thousands of acres of *sal* waiting to come up, if only frost could be eliminated.

No nurse has ever been found which could be grown and under which the *sal* would come up. There is one experiment which has succeeded where *sissu* has been grown as a nurse and the *sal* are coming up very well underneath, but it was started with irrigation and that is only practicable on a small scale and is expensive.

I am trying *sissu* on a small scale but success is doubtful. The frost is very severe and it is followed by a dry hot weather.

Years ago I suggested *chir*. The suggestion was received with a certain amount of hilarity; it was tried rather spasmodically and failed.

But I was not convinced that failure was due to "unsuitable locality" and suspected it might be "unsuitable staff."

Healthy mature or nearly mature *chir* can be found in a line right across the Eastern Circle, and further south than the *sal chandars*, namely, in the company gardens in Bareilly, in Pilibhit near the cinema, in Kheri in various compounds, in Bankatwa bungalow compound (Gonda), in the guest house compound in Balrampur, in Janakpur compound in Gonda (only one and a miserable one), in many places in Gorakhpur.

It was, therefore, certain that *chir* could grow if it could only be started, and that should not be beyond the capacity of a forester worth the name.

There are many advantages to *chir* as a nurse for *sal* in the *chandars*:

(*a*) It is completely frost-hardy to these frosts, in fact seems to like the frost.

(*b*) It is a shade-bearer (almost a shade-demander) for the first year or two in the plains, and gets just what it wants in a good *sal chandar*.

(*c*) It prefers no weeding in the plains (except very exceptionally).

This is a very great advantage as labour is very scarce in the rains.

(*d*) The *sal* comes up very well through it.

It might have other advantages apart from just being a nurse to *sal*, namely:

(*a*) Production of resin much nearer the factories if resin is still valuable.

(*b*) A supply of good straight poles on the plains.

(*c*) A supply of the size material most in demand by concessionists.

(*d*) A cheap softwood supply on the plains.

The results of the experiments to date are that sowings do not succeed under practical conditions. The seed germinates all right but then gets cut off at ground level and, though a percentage get through, the mortality is too great to make this a practical method.

Nor do three months old transplants succeed. They grow all right but something always seems to happen to them. The staff would weed them too much and something or other would eat them. They did their little best, and are now litle bushy coppice plants rather like the burnt *chir* plants on fire lines.

But transplants 15 months old seem to do the trick. It is not yet certain because they were only put out last year and only a small area was done with them. But they have started their second year's growth and are fine green bushy plants one foot to three feet high.

At any rate, success is such that I hope to put out twenty thousand next year.

The method is to sow the seed in May in conical clay pots with no top or bottom. The pots are three inches in diameter at the

top, five inches in diameter at the bottom and eight inches long. The seed is sown at the top narrow end of the pot and grown under a shade in the nursery. The following July, when the rains break, the plants are six inches to one foot long, and the roots have not come through the end of the bottomless pot. The pots are taken complete to the area. A sharp tap loosens the whole ball of earth, and the pot is pulled off over the plant and can be used again. Transplanting like this is simple, with no disturbance of roots and no damage.

Exact costs cannot be given as it has been done on too small a scale yet to work them out. At present, for instance, the pots cost some twelve rupees a thousand, whereas for a large quantity they would not cost more than five rupees; equally the most expensive item is transport to the planting site, because a cart can only take one layer of pots; yet it would be quite easy to make a cheap frame in four or five tiers to hoist on a cart which would quarter the transport costs.

Making holes and planting out is about seven rupees eight annas per thousand at present.

I consider that, on a fairly large scale planted six by six feet, it should not cost more than 15 rupees an acre, largely because there are no subsequent costs for tending.

If this method succeeds—and there seems every prospect that it will—it will have solved a problem which has puzzled the department ever since there was a forest department.

THE INDIAN FOREST COLLEGE

By E. C. Mobbs, I.F.S.

The Indian Forest College was opened at New Forest, Dehra Dun, in May 1938, and has just completed its first year. Its object is primarily to train candidates for the Superior Forest Services of the various Provinces and States of India. In course of time it is proposed also to give "refresher courses" for officers already in service, and when its reputation as a centre for training in tropical forestry becomes established, it is hoped that the college may receive students from other tropical and semi-tropical countries.

The desirability of training future Indian forest officers in India itself, and the special facilities existing for such training in conjunction with the Forest Research Institute at Dehra Dun, as well as the high standard of practical forestry now reached in many parts of India, and the great advantage to students of being able to study Indian conditions at first hand, have all been long recognised. As early as 1926, therefore, an Indian Forest Service Course was inaugurated. The old Forest Research Institute at Chandbagh, made available by the building of the new Institute at New Forest, was constituted as the Indian Forest Service College. Hostels were built and playing fields made, and with the old Institute building as the College, and the surrounding bungalows for the staff, there was every facility for the building up of a good college, which it was hoped would become the centre for the training of forest students from India and the surrounding countries. This ambition, however, did not materialise. Pending the introduction of political reforms, and as a measure of economy, recruitment to the Superior Forest Services was gradually reduced, and ultimately was stopped altogether. The number of students trained at the Indian Forest Service College, therefore, progressively decreased from 12 in the 1926-28 course to only two in the 1930-32 course.

That College was closed in October 1932 with the passing out of the last two students. It was realised that if and when the College were re-opened, it would be better to have it situated along with the new Forest Research Institute at New Forest. The whole of the College and the Chandbagh Estate was, therefore, given up, and with many additions and modifications, now forms the Doon School.

As a result of the recent political reforms, "Forests" were decentralised and transferred to popular control. The suspension of recruitment to the all-India service became, therefore, a permanent cessation of recruitment. The old Indian Forest Service, by whose efforts the vast forest estate of India has been demarcated, conserved and brought under systematic management, will slowly disappear, and in its place each province is building up its own Superior Forest Service. Although some provinces propose a reduction in the gazetted grades of their forest establishments, there is for all an urgent need for recruitment, owing to recent and prospective retirements and the great dearth of junior officers. At the All-India

Forestry Conference held in Delhi in December 1937, the Government of India, therefore, decided to start again the training of students for the Superior Forest Services of the various Provinces and States of India, and the Indian Forest College duly opened for the first biennial course with this object in May 1938. To distinguish this new Indian Forest College from the old Imperial Forest College, which has existed since 1880 for the training of rangers, and at one time also for Provincial Forest Service Officers, the latter has now been renamed the Indian Forest Ranger College.

The new Indian Forest College is housed in the Forest Research Institute building, the upper floor of the south-west wing having been originally designed for this purpose. There are two lecture rooms, one of them specially equipped for the use of an epidiascope, a good biological laboratory, a students' common room, and the necessary office and store rooms. In addition, a good chemical laboratory has been made for the College in the separate building under the Biochemist.

The museums, herbarium, laboratories and workshops of the Forest Research Institute form an important part of the College, in so far as they are largely used for educational purposes by the research officers and college staff, and are available for consultation and use by the students. The Central Library of the Forest Research Institute must also be considered as an essential part of the College, the students being allowed to consult books at all times and to borrow them for limited periods. In these respects the College must be considered uniquely fortunate in its equipment.

A common room library of books of science, travel, biographies, novels, etc., has been started with gifts from various officers at New Forest and of the United Provinces. Many and varied books are required to build up a good library, and if anyone who reads this has any suitable books to spare, the College would be extremely grateful for them. They should be addressed to the Principal, and sent to New Forest P.O., or Dehra Dun railway station.

In the first class there are 16 students, for whom four Class II Officers' bungalows have been converted into hostels, while a fifth bungalow has been converted into a common mess. The hostel accommodation is good, each student having his own bedroom and bathroom, but for the time being in the mess it has been found

necessary to have two dining rooms, no one room being large enough for all the students. If there is no increase in the number of students, the present mess accommodation could be improved by structural alterations. If, however, the number of students increases, as is probable, then it will be necessary to build a new mess providing, in addition to a large common dining room, increased lounge and reading room accommodation.

For sports, the College has three tennis courts and an extensive playing field, providing full-sized hockey and football grounds and a cricket pitch. A pavilion has been erected and is now nearing completion, which will provide adequate accommodation for home and visiting teams. In addition, there are badminton, volley-ball and tenniquoit courts in the hostel compounds, and it is hoped to lay out a good running track on the playing field.

The Staff of the College consists nominally of only two—the Principal and Professor of Forestry, and the Lecturer in Surveying and Engineering, under the general administrative control of the President, Forest Research Institute and College. But in addition to these two officers, the Research Officers of the Forest Research Institute in the Botanical, Entomological, Biochemical and Utilisation Branches, and to a less extent in the Silvicultural Branch, act as lecturers in their particular subjects. The College is again very fortunate in having available as lecturers such an able and well qualified body of research workers, many of whom are also practical forest officers of wide experience.

The qualifications for entry into the College are high. In addition to important conditions regarding age (19 to 23), health and moral character, an Honours B.Sc. degree, not lower than second class, is required. Under the present rules, the degree has to be in Chemistry, Botany or Zoology; or an M.Sc. degree in any subject may be accepted, provided one of these three Sciences was taken in the B.Sc. degree. It has been suggested, however, that an Honours degree in any Science or in Mathematics should be acceptable, providing both Botany and Mathematics have been studied up to the Intermediate Science standard. A good basic knowledge of these two subjects would appear to be an essential preliminary to a training in forestry. Provision has been made in the rules, however, for relaxation of the educational requirements in special circumstances.

The standard of the course is that of the degree course in forestry at a British University. Special attention is given to Indian forest conditions, and tours are made to all parts of India. During the first year the students have toured in the Himalayan forests of the Chakrata Division, and the *sal* and miscellaneous forests of the Dehra Dun, Saharanpur, Haldwani and Gorakhpur Divisions in the United Provinces, the *sal* and miscellaneous forests of the Bengal *tarai* and *dooars*, and the irrigated plantations of Changa-Manga and the erosion areas of the Pabbi Hills in the Punjab. During the second year there will be another tour in the Himalayan forests of the Kulu Division in the Punjab, and a tour to the evergreen, deciduous and dry forests of Bombay and Madras.

In pure forestry, close touch is kept with the Silvicultural Branch at the Forest Research Institute, and modern research methods and results are studied, and wherever possible experiments are visited on tour. Exploitation, Engineering and Utilisation are also studied on tour as well as at New Forest, and already in their first year the students have seen floating and rafting, gravity and mechanical tramways, ropeways and saw-mills, and they have visited paper, katha, resin, bobbin and match factories, and railway carriage and wagon workshops.

With a small class, the cost of training must necessarily be high. For the first class it comes to about Rs. 10,500 (about £750), as follows:

	Rs.
Fees at Rs. 3,500 per annum	7,000
Stipend at Rs. 100 per mensem to cover living expenses*	2,400
Travelling expenses for field training and tours	800
Camp outfit, etc.	300
Total ...	10,500

In most cases the whole or part of this cost is paid by the Provinces and States deputing students to the College, and in no case has a student been admitted without a guarantee of employment on the successful termination of his studies.

* One province gives a stipend of Rs. 150 per mensem.

The present students come from the following Provinces and States:

Bengal	...	2
Bihar	...	2
Bombay	...	2
Orissa	...	1
United Provinces	...	4
Hyderabad State	...	2
Kashmir State	...	2
Kotah State	...	1

It is anticipated that other Provinces and States will wish to send students to the second course, due to commence in April 1940, and some requests for places have already been received. It has been recommended that, for the second course, all students should be required to undergo a preliminary period of practical training under a gazetted forest officer, as has always been required in the case of the ranger students.

From the first year examinations which have recently been held, it can be said that the general progress of all the students has been good. Special importance is attached to practical work in the field, and in silvicultural works, such as thinnings, in mensuration and in surveying the general standard of work has been high.

In sports the College has yet to create a reputation. Games are compulsory, but owing to the tours they are somewhat intermittent. Hockey, football, tennis and cricket are played at New Forest, and on tour volley-ball, badminton and tenniquoit, with football against local teams when opportunity occurs. With only 16 students to draw on, it has not been possible to put up very strong teams, especially as an attempt has been made to give everyone an opportunity to play at some time or other for the College. Friendly games have been played against local teams at New Forest and Dehra Dun, including the Indian Forest Ranger College teams, and against the Thomason College of Civil Engineering at Roorkee. Among the most enjoyable of games have been those against the officers of the Forest Research Institute, headed by Mr. Mason, as an Inspector-General's XI. In the first of these matches the College was defeated, a state of affairs that put the College on its mettle and was atoned for in the return match!

During their Christmas and January vacations, facilities were kindly given by the Indian Military Academy, which adjoins the New Forest Estate, for the students of the College to receive riding lessons. Not only has a fair standard of riding been attained, but great enthusiasm has been aroused, and it is hoped to continue the riding lessons during the next I. M. A. vacation.

In conclusion, it can be said that the Indian Forest College has started well and bids fair to fulfil the hopes and ambitions of all those who have had anything to do with its inauguration and running. We trust we shall not be considered unduly self-satisfied in expressing the opinion that the training given has been maintained at a high standard. The present students have been well selected by the Provinces and States that have deputed them, and they bid fair to become good practical forest officers. If the present type of student is maintained, the future well-being of the forests of India is assured, and those who watch with regret and misgiving the gradual extinction of the Indian Forest Service, at one time the premier forest service of the empire, may take comfort in the fact that every effort is being made adequately to prepare the men to whom the future control of India's forest estate is to be entrusted, and that although they will belong to different Provincial and State Services, they will be bound together by an *esprit de corps* engendered in their common College.

PRIZE DAY AT THE BURMA FOREST SCHOOL, PYINMANA, BURMA, 1939

The Annual Prize Distribution at the Burma Forest School took place at Pyinmana, Burma, on Thursday, 27th April 1939. The Honourable Minister for Forests was unfortunately unable to be present and Mr. A. W. Moodie, Chief Conservator of Forests, presided. The following officers were present on the platform with the Chief Conservator of Forests: The Conservator of Forests, Sittang Circle (Mr. H. C. Smith); the Conservator of Forests, Northern Circle (Mr. D. J. Atkinson); the Deputy Commissioner, Yamethin District (Mr. K. J. H. Lindop); the Divisional Forest Officer, Pyinmana Division (Mr. F. G. Burgess); the Personal Assistant to the

Chief Conservator of Forests (Mr. H. H. C. Pudden) and the Director of the School (Mr. G. D. Warwick).

The Director, in the course of his opening remarks, observed that the school started in Pyinmana 27 years ago with two classes. Now only the Lower or Vernacular Class is functioning as the Upper or English Class was closed down in 1934 owing to shortage of funds and lack of vacancies in the ranger grade. The Lower Class, however, is nowadays filled by foresters of a useful type with good educational qualifications. Numbers of them would possibly have presented themselves for the English Class if it had been open and they deserve every encouragement.

In describing the work for the year, the Director pointed out that the rainy season is utilised chiefly for lectures which are devised to give a suitable background to a course which is necessarily practical. During the dry months of the year the school lives in the forests of the local division and undertakes a useful programme of work which, besides providing valuable instruction, saves the Divisional Forest Officer a good deal of expense. The Senior Class was also conducted on a short tour to various important forest centres in Upper and Lower Burma. This tour was not confined to Forestry as the opportunity was taken *en route* to visit places of interest in Mandalay and Rangoon.

The Director gave some account of the various certificates, prizes and awards available for competition including *The Indian Forester* prize for the best practical man. Recently to encourage an interest in Natural History, Mr. H. C. Smith, Conservator of Forests, has most generously offered two prizes for the best essays on certain set subjects and this year these have been amplified by a prize offered by the Royal Society for the protection of birds. It is hoped that, little by little, it may be possible to build up an interest which may eventually spread to other schools and so throughout Burma.

The Director emphasised the attention paid during the year to the importance of athletics especially in the rains. Games counteract the possible ill-effects of so much book-work indoors and provide the school staff with a good method of testing character and physical endurance. As an innovation this year, athletic sports have been introduced as a contest, not merely at the end-of-term sports day,

but continuously throughout the season. This is achieved by using the "Standards" system and considerable keenness has resulted.

The Chief Conservator of Forests, after presenting the certificates and prizes mentioned, in connection with the re-opening of the Upper Class, that until the recommendations of the Fiscal Committee regarding gazetted staff have been examined and decided on, it will not be possible to make definite proposals regarding the Subordinate Services. In giving some advance information regarding the year's working of the forests he stated that the total revenue for the year was about Rs. 140 lakhs with a surplus of Rs. 80 lakhs. All things considered, this compares very favourably with the surplus of past years. He pointed out that it is not generally recognised outside the Forest Department that we are not merely a revenue collecting agency but that we have to improve, increase and make accessible the yield of the forests before we can collect the revenue from it. He emphasised that we should like to have more money for conserving and improving the forests than the Rs. 12½ lakhs we spent in 1938-39 and that forest officers are of the opinion that we can give to the people of Burma a very good return on any money invested in the forests now.

In addressing especially the students now leaving, he mentioned that as it costs Government about Rs. 2,000 to put each man through the school, it is in the interests of Government, no less than of the men themselves, that they should have a long and useful career. They should set themselves a high standard of honesty and energy and stick to it. The Forest Department comes in for much criticism these days and the men passing out will have plenty of scope not only for carrying out silvicultural work but also for educating the people to a better knowledge of the aims of the Department.

In the afternoon a gymkhana was held on the school recreation ground including a few events demonstrating the physical ability and activity of the students such as a physical drill display, a basket-ball match, a tent-pitching competition and a tug-of-war. Several tents were erected in a corner of the field where the Director and the Staff were at home to visitors.

TIMBER PRICE LIST, JUNE-JULY 1939

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 33-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 32-13-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 21-14-0 to 75-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-9-0 to 1-2-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-12-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-41-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-4-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 42-3-0 to 51-9-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-4-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay .	Logs ..	Rs. 56-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 40-10-0 to 160-6-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 31-4-0 to 48-7-0 per ton.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 56-0-0 to 60-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 18-12-0 to 40-10-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 55-0-0 per ton.
" ..	" ..	" ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-9-3 each.
" ..	" ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-8-0 to 1-3-0 per c.ft.
" ..	" ..	" ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
" ..	" ..	" ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
" ..	" ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-4-0 per c.ft.
" ..	" ..	U. P. ..	Logs	Re. 1-0-0 to 1-6-0 per c.ft.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
" ..	" ..	" ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Re. 0-14-0 to 1-2-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	Re. 0-12-0 to 0-14-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-8-0 to 1-0-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
" ..	" ..	Bihar ..	Scantlings ..	Re. 1-0-0 per scantling.
" ..	" ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	
" ..	" ..	U. P. ..	Logs	Re. 0-12-0 to 1-6-6 per c.ft.
" ..	" ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
" ..	" ..	" ..	Logs 2nd class	
" ..	" ..	C. P. ..	Logs ..	Re. 0-13-3 to 2-4-2 per c.ft.
" ..	" ..	" ..	Squares ..	Rs. 1-8-4 to 3-1-4 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 75-0-0 to 125-0-0 per ton.
" ..	" ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
" ..	" ..	" ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

AUSTRALIAN EXPERIENCE OF SOIL EROSION CONTROL

(1) GULLY EROSION

By E. S. Clayton

New South Wales Dept. Agric. Leaflet, 1936. *Government Printer Sydney.*

This is a very practical little guide to one phase of erosion control, namely, the curing or plugging of gullies in eroding farm and grazing land. It emphasises that gully control is merely a means to an end, which is to get the plant cover re-established; but in many cases where erosion has gone deep, some form of simple engineering work is essential if the rot is to be stopped.

We all know what an erosion gully looks like. What we want to learn is how it can be mended. This leaflet contains a number of sound suggestions. First, the gully head must be prevented from digging further back; this can be done by pegging a wad of straw into the undermined bank and pinning this down with posts and cross-battens. Or it can be done by beating down the undermined portion into a gentle slope, provided of course that there is a good prospect of getting plants to cover it up. Or in shallow gullies it can be done by a check dam placed close to the head, so that the hole fills up with a cushion of silt.

Next the bed of the gully must be altered from a V-shape cleft to a series of broad steps. This can best be done by making a series of small check dams all the way down, using any local material that comes handy. The most difficult case is soft sand when nothing but sand is available.

(2) REPORT OF COMMISSION ON EROSION IN VICTORIA

Feb., 1938. *Government Printer, Melbourne.*

This excellently illustrated and brief report shows very clearly that all the phases of erosion so familiar in India, namely, sheet-washing, gullies, stream-bank cutting and landslides, are all at work in Australia, and the causes are also the same—bad field technique and heavy grazing. The report rightly emphasises the need for better methods of reducing run-off, and concentrates attention upon *contour banks* as the best means of resuscitating pasture sward which has been broken up or destroyed.

In planning the altered course of a trained stream, it points out that the object should be, not to shorten the course, but to lengthen it by winding, because this is nature's own method of handling the job. Every bend that is cut out by straightening the course means a steeper course and a greater potential strength for carrying silt down the river. The first thing a layman wants to do as soon as he becomes interested in stream training is to straighten it out!

The situation in Victoria is apparently being handled by a Soil Conservation Commission made up of river users, water users and soil users formed into district units and given some executive powers to coerce the owners who will not co-operate. But the trouble in Australia is the same as in India—there are not nearly enough technically trained men to guide and control the work on a scale commensurate with the needs of what is rapidly becoming a desperate situation.

R. M. G.

DOMESTIC OCCURRENCES

Birth.—STARTE.—On 29th June, at the Canada Hospital, Nasik, to Maisie, wife of H. W. Starte, I.F.S., Conservator of Forests, a daughter.

EXTRACTS

THE RELATIVE STABILITY OF INDIAN VEGETATIONAL TYPES

By H. G. Champion,

Conservator of Forests, Naini Tal

[*Presidential Address delivered at the Eighteenth Annual Meeting of the Indian Botanical Society at Lahore on 7th January* 1939.]

I.—Introductory

To the casual observer, most of the familiar types of vegetation seem to retain their general appearance and composition over long periods of time; what he remembers from his childhood as open thorny scrub 8 to 15 feet high, perhaps with here and there a grove of mangoes, still looks the same when he reaches manhood and even old age; and similarly for the open grassy plain, the sandy river bed with grassy tussocks, and the closed forest on hill and plain.

If his attention is drawn to the matter, the older man will quite probably tell you that there was tree forest in his youth supplying all local needs for timber, tools and fuel, where now you see only open thorny scrub; but sometimes, on the contrary, he will tell you that a certain tree jungle was only a stony gravel bank or open grass land in his youth. The close observer of such changes—we now term him a plant ecologist—quickly realises that, except in unfrequented parts of the country, change, not stability, is the order of the day for the vegetation occupying the soil. The old villager remembers only the outstanding instances, but the ecologist finds that it is exceptional in India to find areas which do not yield evidence direct or indirect of having changed considerably from a former condition and of being likely to change further in the future The tempo of these changes varies within very wide limits, being as a rule faster the more recently and intensely human influences have impinged on the area considered.

II.—Existing Vegetational Types

India has a wide range of vegetational types corresponding with its exceptionally wide range of climatic conditions, from the edges of the eternal snow to the hot constantly moist forests of the Western

Ghats and the hot continuously dry desert vegetation of Sind and Rajputana; also to the wide variation in soil from loose dry sand to stiff clays, laterite, black cotton soil, and the dark humus soils of the temperate hill ranges. A survey of the forest and shrub types of India and Burma was published in 1936 and studies have been published, several of them in the *Society's Journal*, of non-forest types such as the low desert vegetation, lake side herbaceous and aquatic floras, etc. In my presidential address to the Botanical Section of the Indian Science Congress in 1937, I developed the thesis that forest was what is known as the climax vegetation over almost the whole of the country, with only relatively minor exceptions notably in the dry eastern areas and the tops of the Himalaya above timber line, and this view appears to be shared by the majority of writers on the subject.

For the purposes of this address, we need make only the simplest sub-division of the vegetative cover as we find it into:

(1) Grassland,

(2) Savannah forest (*i.e.*, open woody cover with herb vegetation between),

(3) Scrub,

(4) Deciduous forests,

(5) Evergreen forests,

though references may be made to aquatic vegetation, cultivated crops, the special vegetation of our estuaries, etc. It is proposed to consider representative occurrences falling into each of these subdivisions from the point of view of their past history, known or deduced, the factors affecting their present apparent stability, and finally their probable future.

III.—EVIDENCE OF CHANGE

It is necessary first to consider briefly in what direction evidence of past history may be available if looked for. Firstly, there may be written records as in the well-known instance of the hunting exploits of the Moghal Emperors in Etawah District; here the level tree forest with local heavy grass, then frequented by rhino, etc., has in two-three centuries become tortuous ravine land with thorn scrub and only poor thin grass.

Secondly, we frequently have direct archæological evidence of which perhaps the best example personally known to me is just outside India in what is known as the Dry Zone of Ceylon, now under almost unbroken forest over hundreds of square miles, but 1,000 years ago supporting a great population, the ruins of whose cities and irrigation works are scattered throughout.

Less obvious evidence of a similar type is supplied in nearly all our hill tracts by traces of ancient terracing of the slopes, proving they have once been completely cleared and cultivated.

Again, the vegetation itself may provide useful evidence of changes which must have occurred, or at least influences which must have been at work, during the last century or so. A common clue is the presence in a forest area of a patch of growth of varying extent, usually on good soil or a warm slope, and near water, differing from the surrounding growth in specific composition and form, and characterised by the presence of big branchy shade or fruit trees such as mango, *mahua* and tamarind and often exceptionally large and branchy specimens of the jungle trees, also proving as definitely as any written record that here is the site of an old clearing and settlement with the manifold influences which man and his grazing herds formerly exerted in this spot and its vicinity.

Often associated with the type of evidence just mentioned, but still less obvious to the layman and very liable to be overlooked by the botanist who is not also a forester, is evidence supplied by the average age and uniformity of the tree crop an area carries. A forest devoid of scattered trees which have reached the natural span of life of the constituent species cannot be in equilibrium with the habitat, and influences must have been at work accounting for their absence. As an example of this, I may quote an apparently stable pine forest in Kumaun well covered with trees of all sizes except the biggest which other similar sites normally carry. Age studies showed that these trees despite their range in girth from three to six feet were all of very much the same age, 100—120 years (the natural term of life is over 200) and on closer examination traces of partial terracing were discernible here and there. It can hardly be doubted that the whole slope had once been cleared of trees for the shifting cultivation previously practised; further support for the deduction

was available in the general historical records of the tract which shew that it formerly carried a relatively dense population.

This general type of evidence has to be accepted cautiously or the student finds himself begging the question he has set himself. The extensive hill tracts between Bengal, Assam and Burma offer a most interesting ecological problem in this way. Vast areas now carry a dense growth of bamboo (primarily *muli* or *Melocanna bambusoides*) with scattered trees of species mostly found in the wet tropical evergreen forest such as *Dipterocarpus alatus*, *Mangifera longipes*, *Amoora*, etc. Clearings for shifting cultivation are known to become covered in time by this bamboo and to leave scattered trees of the original forest, and the natural deduction would be that the type has originated over the whole area in this way, but much further evidence is necessary before this hypothesis can be considered as proved.

The example just quoted also provides an instance of another type of evidence to be considered, *i.e.*, indications in the composition of the vegetation itself that it differs, for no reasons apparent in the site and soil, from the type which is associated with such soil and site elsewhere. Thus, the soil and site in our example are often such as elsewhere carry closed evergreen forest including the species of which isolated examples are found standing over the bamboos or on steep slopes and in sheltered ravines. Such an area should, one deduces, also carry closed evergreen forest: surely must have done so in the past, and perhaps may yet do so again in the future if restraining influences are kept away or removed.

Other instances are provided by the predominance of thorny and inedible species in almost all the remaining woodland of our thickly populated districts, and by the predominance of the hardiest species (especially gregarious ones like *Shorea robusta*) in the more extensive forest areas. I have previously quoted a striking example of this from the W. Himalaya, where a single spur rising from a river at 2,500 ft. to about 6,500 ft. carried residual forest at three levels; it had at the bottom almost pure stunted *sal* forest with a little thorny undergrowth of *Carissa*, *Randia*, etc.: then after a break a pure *chir* pine forest with no undergrowth whatever: and finally at the top pure oak. The oak is very hardy to lopping and had a

mixture of *Rhododendron* and *Pieris* which was in far higher proportion in the opener fringe, than in the better stocked forest further from human habitation, these species being inedible to cattle and of poor fuel value.

The evidence so far considered has dealt with past changes; there may also be evidence of changes to come. One example from the plains and one from the hills will suffice. Many old woods of *sissu* (*Dalbergia sissoo*) will be found to have no young *sissu* on the ground but a copious supply of *Holoptelea* which will replace the *sissu* as it dies out from old age. Similarly examples are common of a maturing blue pine wood with ample regeneration of silver fir but no young blue pine.

IV.—AGENCIES OF CHANGE

We will next review the chief agencies at work on the vegetation likely to affect its stability and bring about changes, dealing firstly with injurious agencies and the opposite effects of removing or restricting them, and then with the results of intelligent human endeavour. Most of these agencies have been mentioned already. To them must be added the natural changes taking place in new or disturbed soils with the passage of time.

1. *Clearing for Cultivation.*—This in India normally means the destruction of woody growth of some sort and its replacement by cultivated, usually herbaceous crops. Occasionally grassland is similarly treated.

2. *Clearing round Cultivation and Settlements* by removal of building material and fuel, sometimes with intentional destruction of trees to improve grazing or to keep away wild animals; burning and lopping for fodder are important contributory factors. The results vary with the original vegetative type, but the general effect is degradation of high forest to savannah types with open tree cover and herbaceous or shrubby undergrowth, the latter with the weeds of cultivation and waste places prominent. Where cattle are herded, nitrophilous vegetation becomes conspicuous. The trees tend to become limited in time to a few species, either useless ones or favoured fruit and shade trees. Invasion of introduced weed species frequently follows, *Lantana* and *Eupatorium* being outstanding examples which have so altered conditions that we cannot yet say what the ultimate outcome will be.

3. *Grazing.*—All original vegetation is of course subject to the grazing and browsing of the wild animals naturally associated with the site, but on available evidence though this influences in some degree the proportions of the several component species, it does not affect the general type or form of vegetative cover. The grazing of domestic herds on the other hand is a totally different matter in that the intensity factor is increased beyond all proportion to the stock of wild animals they displace, and with fire constitutes the most influential agency now affecting the vegetation. Such heavy grazing in a forest usually affects it mostly through its deterrent action on the regeneration of the tree species; by trampling and exposure of the soil, conditions are rendered more difficult for the seedlings and such as survive are exposed to being eaten by the cattle, only some species being adequately protected by non-palatability. The intensity factor is important, for a light degree of grazing by reducing the undergrowth and exposing the mineral soil may actually facilitate the establishment of tree seedlings especially where there has been much accumulation of raw humus as in our fir forests. It will be noted, however, that in both cases the natural course of events will be altered by the introduction of the domestic grazing factor.

Considering herbaceous growth, grazing again exerts a very far-reaching influence, varying much with vegetative type and locality and grazing intensity. Inedible species are always favoured, *e.g., Cassia spp., Asclepiadaceæ,* etc., as also are thorny ones, *e.g., Mimosa, Zizyphus,* etc., and ground lost by the more edible herbs and grasses. On the other hand, grazing of grassland on old cultivation, etc., frequently prevents or delays its occupation by the coarse tall grasses.

The kind of cattle grazing is also very influential, the browsers, goats, buffaloes and to a less degree sheep, checking woody growth far more than cows and horses. Heavy grazing by browsers may turn dense high forest into grassland or scrub in a tree generation by inhibiting tree regeneration whilst the old crop slowly dies out; this is visible throughout the fir forests of the Himalaya.

The direct results of grazing are accentuated by the activities of the accompanying graziers who lop the fodder trees for their flocks and herds, encourage the extension of grassland by burning and girdling and meet their own needs for building material and fuel.

4. *Burning.*—Much has been written, mainly by foresters, of the effects of burning on the natural vegetation of the country, and it cannot be repeated here. The general effect is to degrade the vegetation to a form typical of a drier climate than is indicated by the meteorological records, thus moist evergreen forest is degraded to deciduous forest or grassland, deciduous forest to savannah, and moist coniferous forest to scrub or grass. Where the general facies is not much altered, the species composition is altered in favour of the fire hardy species; thus in the Gangetic plain, we hardly know what the natural forest was like before it was affected by human influences including burning, but there is ample evidence that most of the forests which are now almost pure *Shorea,* must have been much more mixed, with *Shorea* rare or even absent in many places. Again the present monsoon savannah type forests contain little except the most fire hardy species such as *Lagerstroemia parviflora Sterculia villosa, Bombax,* etc., though there are plenty of others now limited to favourable moister spots which could grow equally well with them if it were not for the periodic fires associated with human settlement.

5. *Abandonment of Cultivation.*—The succession of vegetation which occupies abandoned arable land provides one of the most conspicuous examples of ecological changes and all of us must have personal knowledge of several examples. Factors to be kept in mind are the duration and intensity of the cultivation which determine the extent of survival of remnants of the original vegetation, the surrounding vegetation which controls the relative ease of colonisation of the vacant site, and the incidence of grazing and burning. Long continued cultivation of land formerly under forest is liable to alter the soil both physically and biologically so radically that reoccupation by forest may be extremely slow. Instances could be quoted of old fields in the middle of a forest which after 50 years or more still appear much as they must have done a few years after they were abandoned. However, more generally, grasses and other herbaceous vegetation quickly occupy the ground; shrubs and trees, especially those with effective seed dispersal mechanisms soon follow, particularly on old banks or bunds. Further development is too varied to discuss here, but in a general way, if restraining influences are light or moderate, there is a slow progression to the vegetational form appropriate to the climate and soil as indicated by undisturbed areas in

the locality, and a still slower progression to the same specific composition. If the restraining influences are more effective, the progression continues to some stage short of this, and then appears to become stabilised as what is termed a sub-climax.

6. *Stoppage of Intensive Grazing.*—In any heavily grazed area where grazing has been excluded or considerably reduced, marked changes soon become apparent in the ground vegetation, often very quickly if conditions are at all favourable. There may be a marked increase of the more delicate edible grasses and herbs, but this may be followed by their displacement by the coarser perennial species (and so deterioration as grazing land). After this, progression usually takes place much as described in the preceding section towards the climax vegetation of the locality. Where the grazing ground was degraded forest, protection will have some of the effects just described, and may lead to copious regeneration of tree species re-establishing a closed tree crop which will bear for a century or more the signs of its past history.

7. *Fire Protection.*—It is only in the last decade or so that the far-reaching effects of excluding fire have been realised, just as the great influence which burning has had on our vegetation was also not adequately grasped. Grassland is still mostly burnt annually, partly in the belief that it improves the species composition, but mainly to induce an early flush of edible new growth in the lean months from March to June. Burning grassland tends to check or inhibit tree growth, and so protection usually results in its development, *e.g.*, *Macaranga* in the North Bengal *sal* tract. Burning in deciduous forests prevents or checks the development of all fire-tender species, and almost all evergreens are fire-tender; protection accordingly results in the closing up of the forest with a greater variety of species and in the addition of a proportion of evergreens varying with the climate and site and other factors. Fire protection of most types of scrub growth results in their progression to tree forest, *e.g.*, temperate montane scrub to *Pinus excelsa*.

8. *Human Control.*—Our object in striving after an understanding of these changes is twofold, *viz.*,

(1) the purely scientific thirst for knowledge and understanding of ultimate causes and

(2) the application of the knowledge gained to the control of our environment to make it conform to our wishes.

Much long established agricultural practice is of course the application to the control of vegetation of experience gained by long experience and much trial and error experiment. The proper management of Indian grassland and grazing to which so much attention has been drawn of late, is a big field which is calling most urgently for a large force of scientists. I leave this aspect of my subject to those more competent to describe it. The introduction of systematic forest protection and management some 70 years ago has given results in all parts of this country which are full of interest and importance to the student of ecology. The countless instances where forest growth has since been completely destroyed right up to the legal boundaries then laid down, so that the protected forest is mistaken for an artificial plantation, may first be cited as a conspicuous feature. Within the forest the most important changes have resulted from protection against uncontrolled felling, from fire protection and from limitation or local exclusion of grazing. Again only one or two instances can be quoted. There are many examples also where inferior scrub has now developed with protection to valuable productive forest. In Bengal and Assam, a dense evergreen undergrowth, which has developed in *sal* forests, has completely inhibited the natural regeneration of the *sal*; *sal* however is by far the most valuable timber tree, so that to maintain it and get up a new crop of *sal*, special measures have to be taken to replace the evergreen undergrowth by a light grass growth, by cutting and burning. Ecologically speaking, a climax forest of unknown composition but evidently largely evergreen and probably with only local patches of *sal* on suitable sites has in the past been converted by human agency probably through grassland and savannah into a nearly pure *sal* sub-climax type which would progress again towards the climax with continued fire protection, but for timber production purposes has to be brought back to and maintained at the *sal* fire sub-climax. Just as the selective destruction of useful constituents of a mixed vegetation has been a marked feature in the past, so the selective protection and extension of desirable species is an important objective of intelligent management, and is gradually bringing about far-reaching changes in our woodlands, and in similar ways it is to be anticipated it will do the same in our managed grasslands and mixed grazing areas. The opinion has been expressed that "India has no

natural grassland area," whereas it seems quite likely that an increasing area will have to be maintained by artificial control of other vegetational types.

V.—CHANGES IN PROGRESS IN DIFFERENT TYPES

1.—Grassland—

(*a*) *New riverain grass of North India.*—*Saccharum spontaneum* is the characteristic species and may be maintained for some length of time by flooding with redeposition of sand by burning and grazing. In time however it very usually progresses to the *khair-sissu* and *Populus-Tamarix* types of forest. As a type it is always being reproduced in suitable localities, but on a given area is shortlived.

(*b*) *Older riverain grass of North India.*—Grassland of various types is typical of the more stable lower alluvium. The grasses are mostly tall and coarse but provide valuable grazing from new growth after burning. The wetter sites often remain under grasses such as *Phragmites Karka* and *Saccharum procerum*, etc., until silt deposition raises and dries them but the drier and higher sites are slowly colonised by tree growth, fire hardiness and often frost hardiness being essential to success. Fire protection results in increase in the tree growth and it is evident that the grassland would soon progress to monsoon forest as the next stage. The higher old alluvium also carries a great deal of grassland again of tall coarse grasses such as *Anthistiria gigantea, Erianthus spp.*, etc., with *Imperata*. The results of protection indicate that much of this is also fire conditioned while other parts appear to be old clearings and will progress to monsoon forest, notably *sal* forest.

(*c*) *Temperate grasslands of South India Hills.*—Ranganathan and Bor have recently written on this type, the former holding it to be a stable true climax, and the latter believing it to have been mostly preceded by the evergreen forest now limited to the sholas persisting only on favourable sites; I had previously upheld the latter view.

(*d*) *Alpine grasslands.*—Detailed studies are wanting but this may well be a true climatic climax.

2.—Savannah types—

(*a*) The riverain savannahs have been mentioned with the evidence that whilst they may frequently be a natural stage in the

primary succession from river deposit to closed forest; they tend to be maintained as such by fire and grazing.

(*b*) Deciduous savannah forest is met with all over the hills and plateaux of Central India especially in the rather drier tracts and sites. In many parts progression to closed forest can undoubtedly take place with protection but other parts may well be viewed as the climax type.

(*c*) *Thorn savannah* may be taken to cover much of the open forest of the Punjab *rakhs* and the open dry *Acacia* forests of the older alluvium and Central India. Evidence can be found indicating that much of the latter owes its existence to the degradation under human influences from the drier variations of the deciduous monsoon forest, but the Punjab semi-desert type though anything but free of human influences, is not far removed from the climax type. How rapidly the *rakhs* are disappearing is known to every resident in and visitor to the Punjab.

3.—Deciduous forest—

The summer deciduous monsoon forest is perhaps the most characteristic in India. It includes the *sal* and teak bearing forests occupying most of the remaining forest area and has provided most of the examples already quoted above of change and human influences. It is indisputable in many places that it has displaced evergreen forest and abrupt changes are constantly met with which are definitely not traceable to changes in rock or soil. Owing to the sensitiveness of evergreen seedlings to exposure and still more to fire, and probably to the soil changes which have taken place, the return of the evergreen is usually a very slow process and the deciduous type appears very stable. At the same time, though composition may be different, the general form of the deciduous forest is probably the true climax vegetation of a great part of the country.

The *khair-sissu* forests of new riverain soil have already been mentioned and provide one of the best available examples of a type which is always only a phase (sere) in vegetational history. It never regenerates itself on the same site but provides shelter for the establishment of a new stage on the way to the typical monsoon forest, a phase characterised by such trees as *Holoptelea*, *Albizzia*, *Bombax* and *Adina*. In drier climates, the poplar—*tamarisk* forest gradually

changes to the thorn forest of the upper Indus basin. Soil changes are obviously closely associated.

The status of our rather limited temperate winter deciduous forest is less clear, but it is certainly frequently succeeded by coniferous forest or evergreen oak. Elsewhere it seems to be stable and conditioned by soil and moisture conditions.

4.—Scrub types—

Except for desert scrub and alpine scrub (notably *Rhododendron* spp.) all the main scrub types met with appear to be quite definitely ascribable to degradation types from high forest, or several stages in primary or secondary succession. Examples are the shrubby growth of *Wendlandia, Melastomaceæ,* etc., of the south, *Dodonæa Woodfordia, Adhatoda,* etc., of the north, *Indigofera, Spiræa,* etc., of the temperate hills, and the dwarf mangrove of our deltas.

5.—Evergreen forest—

The moist tropical evergreen forest appears to be the climax type wherever the annual rainfall exceeds 80 inches and the dry season is not prolonged. If this is correct it must once have occupied a much larger area than it does now, even allowing for its possible absence on unfavourable soil types. Mention must be made of our tidal forests as these are so obviously changing as the land is raised higher and higher by deposition of silt, and by the varying salinity of the water submerging them. Our coniferous forests as a whole are decidedly stable though examples of the fluctuating equilibrium with broadleaved forest and between the several species of conifer have been mentioned.

In conclusion, a few remarks are called for on the nature of the climax vegetation to which repeated references have been unavoidable, the end stage to which all existing vegetation is presumed to be progressing for the first (primary succession) or subsequent (secondary) time. Still the most widespread view is that developed by Clements that for a given climate both vegetation and soil tend to develop to a single climax form whatever the initial differences; the climax vegetation is not expected to be absolutely uniform as there will always remain local factors opposing the climatic ones checking attainment of the climax (giving us a preclimax) or permitting overstepping to a more advanced stage (a postclimax). Other workers

find themselves unable to accept this monoclimax view and consider that each markedly different type of site within a climate has its own climax of equal status with the rest, and consider this multiple climax conception to fit better the available information. The difference between the two views has perhaps been overstressed in some quarters and is perhaps not of very great practical importance.

The object of this address is to invite attention to the widespread occurrence of vegetational change both forward or successional and backward or retrogressional, and to the importance of the study of these phenomena with a view to their control for the benefit of the country. To what extent that objective has so far been attained may be indicated by the number and scope of ecological contributions to the Society's Journal in the future. Although Volume I has a useful paper by Dr. Dudgeon, there have been very few since.—*The Journal of the Indian Botanical Society, Vol. XVIII, No.* 1, 1939, *pp.* 1—12.

WANTED A DICTATOR?

"India needs a dictator." This has been repeated in our hearing again and again so that we have been forced at least to consider whether such a statement has any truth in it. The more we consider it, however, the more we feel inclined to agree with it. For, as we look around us, we see that the progress is too slow. In agriculture and we believe in most other matters, India seems to need a strong hand. Crops in Government farms or in farms connected with agricultural institutions seem definitely to be superior to the crops of the villagers just across the road. But many of these villagers do not seem to want to change either their seeds or their methods of cultivation, both of which have been handed to them by their fathers and their grandfathers. A cow in an agricultural institution may be giving 40 to 50 lbs. of milk a day, but that of the villagers is only giving 4 to 5 lbs. per day, yet how many of such villagers are seriously considering the improvement of their cows by careful breeding and selection? A man using modern implements can now easily take care of 20 to 50 acres of land, whereas one using a *desi* (country-made) plough can take care of 5 to 10 acres only.

Can any one, therefore, deny the fact that if a strong hand is used the progress in our rural areas would be much more rapid than it is now? The above, however, do not seem to us to be so pressing as some other problems in agriculture.

One of the things we would like to see the government authorities adopt as part of their immediate programme is the control of erosion. It has been pointed out again and again that erosion is robbing our nation of our very life blood as this process impoverishes the soil to such an extent that a field, once considered to be rich, is sooner or later depleted of its fertility. In order, therefore, that the nation be no longer robbed of its heritage given to us by God, we plead that this waste in the form of soil carried down to the ocean be stopped at once. A country-wide survey of agricultural lands in the province in order to find out the extent of damage done and also in order to find out where immediate steps should be taken to prevent this loss is, to our minds, very necessary for not only keeping up the fertility of our lands, but also for reclaiming those that are almost beyond hope of any possibility for reclamation. Such steps, we have no doubt, will help to increase the productive power of the agricultural lands in this country, a thing sorely needed when a good part of our agricultural population go from one day to another without sufficient food. For it is indeed painful to see, as one goes around in these provinces, the dreadful loss that is caused to the country by man's attitude of indifference to one of the most important factors of production, namely, land. Land that should be capable of producing the best kind of wheat that there is anywhere in the world, is now only capable of producing *bajra*, a millet, so poor that it does not even pay the cost of producing it. Some lands have been rendered almost completely useless by erosion so that only grasses of the very poorest kind would now grow on them. It is high time, therefore, that something more be done about it sooner or later, besides the very feeble attempts made by the Forest Departments for attacking this very serious problem.—*The Allahabad Farmer, Vol. XIII, No. 2, March* 1939.

FORESTERS WARN OWNERS AGAINST DENUDING METHODS

Washington.—The Forest Service has declared that if private ownership of vast timberland domains is to continue, the owners must conform to the nation's forest policy.

F. A. Silcox, Chief Forester, making his annual report to Congress, said the alternative is "more control over private forest lands."

For more than 300 years, he said, American forests have been "chopped, burned and depleted; instead of being cropped they have on the whole been exploited and ravished." That must stop if the nation is to avoid a "wood famine" and a flooded, eroded land, he asserted.

Mr. Silcox recommended to the previous Congress legislation to extend public regulation to curb wasteful production practices and to require replanting of cut-over lands. To-day he said that recommendation had "excited interest and discussion."

"Majority opinion within forest industries is probably against it, though some progressive leaders believe it necessary and inevitable," he said. "Public opinion, determined that exploitation must be stopped, seems largely in favour of it."

Proposals for public regulation will be placed before congressional committees, Mr. Silcox said. A recent inventory of the nation's forest resources indicated, he said, that there are about 462,000,000 acres of commercial forest lands. If properly cared for, this area, Mr. Silcox declared, should provide sufficient wood for the future.

"On the forest land we have," Mr. Silcox said, "we need more and better forests to help underwrite industries dependent on them—saw-mills, planing mills, remanufacturing plants, furniture and other factories. In normal times these forest industries had a gross production that averaged close to $2,000,000,000 each year and provided pay rolls supporting about 6,000,000 persons."

Mr. Silcox contended that private owners have not tackled the jobs of rebuilding and improving their forests on anywhere near an adequate scale. The service said that an annual federal investment of $225,000,000 for restoration, rehabilitation and acquisition of forest lands could, over a 20-year period, raise the annual forestry income to more than $5,000,000,000.

The forest service has recently apportioned $10,000,000 for construction of forest highways, truck trails and foot trails in forest lands throughout the nation. The total includes $6,666,667 of the Forest Highway Fund required to be expended on public highways within national forests. The roads ordinarily are considered a part of the state highway system.

The remaining $3,333,333 has been set aside as a forest road development fund for construction and maintenance of truck and foot trails essential for fire protection and forest administration, as well as forest use, development and recreation.—*Christian Science Monitor, 3rd April* 1939.

THE TANNING TRADE

The modern tanning and leather industry, which was first introduced by Europeans, may now be regarded as an Indian industry. With the exception of one, all the tanneries on the banks of the Ganges in Cawnpore and on the banks of the Jumna in Agra are now owned by Indians. Similarly Indian enterprise has made its headway at other centres of tanning and leather industry—Bengal, Bombay and the South.

India, with its estimated average annual slaughter of 20,000,000 cattle, is the largest single producer of cattle hides, the United States of America being the next largest. The average annual output is about 6,000,000 skins. The Hide Cess Committee of 1929-30 stated that India produced on an average about 25 million cow and buffalo hides annually.

The United Provinces produce one of the best class of hides, specially in the western districts of Agra, Aligarh, Meerut and Moradabad, where grazing is good,

Tanning is of two kinds, vegetable and mineral or chrome tanning. Vegetable tanning is also called bark tanning as the principal ingredient, tannin or tannic acid, is obtained from the *Babul* tree, whose bark is rich in tannic acid. It grows abundantly all over the Province. The tree quickly attains maturity and is self-seeding. When used along with a suitable quantity of *myrobalams* (*Terminalia chebula*), the fruit of a tree growing in the Central Provinces, *Babul* bark (*Acacia arabica*) provides excellent tanning material.

Madras Initiative.—During the last two years tanners in Cawnpore have been faced with the increasing scarcity of *Babul* bark. The price of *Babul* bark has increased to a point at which *Wattle* bark, imported from South Africa, compares favourably.

The scarcity of *Babul* bark is principally due to the increase in the number of tanneries and the absence of any organised plan for replanting of trees, which are cut down every year for commercial timber, firewood and the manufacture of charcoal.

The introduction of chrome tanning revolutionised the leather trade, for this process is more rapid and produces more durable leather. Production of chrome leather is entirely a chemical process, chromide acid taking the place of tannic acid. The production of chrome leather was first introduced in the Madras Presidency and was subsequently taken up by the United Provinces tanneries.

Huge quantities of leather, both vegetable tanned and chrome tanned, are being exported from the United Provinces and other centres to Mesopotamia, Canton, East Africa and South Africa.

Before the Ottawa Agreement, German and other continental tanners had a virtual monopoly of the supply of chrome leathers to the United Kingdom. The imposition of an import duty of 15 per cent. *ad valorem*, subsequently raised to 30 per cent. in the case of calf hides, on continental leathers (while Indian leathers were admitted free of duty) enabled the Indian tanner to obtain a large share of this market. The export of Indian chrome leathers to the United Kingdom rose from 400,000 square feet in 1931 to over 7,000,000 square feet in 1935, and India became the largest supplier of chrome tanned hides to the United Kingdom.

In 1937 in the total imports of Box and Willow Calf and Box and Willow Hides into the United Kingdom were 40,611,000 square

feet, and of this India's share was 11,658,000 square feet, that is, 28.7 per cent. of the total imports. But in 1938 India's share fell to 16.6 per cent. in the first ten months.

The Indo-British Trade Pact offers fresh opportunities to the Indian Tanner to capture the United Kingdom Market.—*The "Statesman"—Indian Industries Supplement, 29th April* 1939.

PLASTICS OR WOOD?

ECONOMICS OF RADIO CABINET PRODUCTION

Mr. H. V. Potter, Managing Director of Bakelite, Ltd., in an address which he gave recently to the Plastics Group and the Liverpool Section of the Society of Chemical Industry, referred to the economics of moulded productions compared with those constructed of wood.

In the case of the latter, he said, the cost of the wood was small. Parts had to be cut to size, planed and sanded, fitted together by glue or nails, and finished by staining and polishing. It was the labour that cost most money in the assembling and finishing processes. When household goods were produced in big quantities, moulding might prove much cheaper than when wood was used.

When the radio industry was in a more flourishing condition and individual manufacturers turned out quantities of one model up to 100,000 and even 200,000, moulding was the most economical method of production. Since the quantity had fallen, manufacturers found they could make a smaller number of radio cabinets in wood at a cheaper rate.

As soon as the demand increased, and if television came in at a price at which the general public could afford to buy it, then, in his opinion, manufacturers would again turn to plastic moulded cabinets. Quantity was the essence of the problem. The number of articles to be produced had to be large to keep down dead charges due to capital outlay.—*The Timber Trades Journal, Vol. CXLIX, No.* 3270, *April* 29, 1939.

WOOD PULP PROSPECTS

Developments in the wood pulp market have a special importance to India's paper industry in view of the recent report of the Indian Tariff Board. Throughout 1938, reports the *Swedish Economic Journal,* the Swedish pulp market was very unsatisfactory. Only a few fresh deals were concluded, and then chiefly in conjunction with the conversion of earlier contracts. As the 1938 output was practically sold out by the beginning of the year, the sales were primarily for shipment in 1939. In spite of a considerable voluntary restriction of output by the European producers of sulphite pulp, the price-level was weak throughout the year. Sulphate prices also showed a downward tendency, and the same applies to mechanical pulp. The volume of exports, converted into dry weight, dropped more than 22 per cent. The decline was greatest in the case of sulphate pulp (25 per cent.) and smallest in that of mechanical pulp (15 per cent.).

EXPORTS IN THOUSANDS OF TONS DRY WEIGHT

	Oct. Dec. 1937.	*Oct. Dec.* 1938.	*Jan. Dec.* 1937.	*Jan. Dec.* 1938.
Sulphite Pulp	372·6	327·7	1,302·7	1,013·8
Sulphate Pulp	247·1	220·1	896·7	686·8
Mechanical Pulp	108·0	89·7	353·1	299·3
Total ..	727·7	637·5	2,552·5	1,981·9

It was hardly possible to discern any improvement in the situation during the first two months of the current year. Selling operations have been on a very limited scale and, as before, have been mainly in conjunction with the conversion of earlier contracts.—*Capital, 18th May,* 1939.

NOTICE

Manual of Indian Timbers

BY G. S. GAMBLE.

Copies of this book, which is a reprint of the second edition with some corrections and additions, printed in 1922 by Messrs. Sampson Low, Marston and Company, Ltd., London, are available for sale at the Forest Research Institute at the reduced price of Rs. 5 per copy only excluding postage charges.

The price has been purposely reduced in order to clear out the stock of this useful and handy book.

Forest Officers and others who wish to buy the book should send their requirements to the President, Forest Research Institute and College, New Forest P. O., Dehra Dun.

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons)					
	MONTH OF MAY			2 MONTHS 1ST APRIL TO 31st MAY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	75	24	10	360	282	10
French Indo-China	65	149	146	598	648	651
Burma ..	12,740	12,477	14,016	27,090	24,720	25,357
Java ..	310	614	426	504	721	945
Other countries ..	35	..	..	387	..	..
Total ..	13,225	13,264	14,598	28,939	26,371	26,963
Other than Teak—						
Softwoods ..	1,217	1,279	1,651	2,745	3,597	3,319
Matchwoods ..	714	1,128	620	1,815	1,872	1,970
Unspecified (value)	..	..	..	..	..	..
Firewood ..	127	33	33	163	95	60
Sandalwood ..	..	19	25	15	26	30
Total ..	2,058	2,459	2,329	4,738	5 590	5,379
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	77	38	70	77	97	122
Plywood (tons) ..	428	372	613	1,184	942	1,034
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	505	410	683	1,261	1,039	1,156
Total Volume of Wood and Timber ..	15,788	16,133	17,610	34,938	33,000	33,498
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	11,955	41,619	8,428	29,381	67,460	25,209

Seaborne Trade and Navigation of British India for May 1939 :

IMPORTS

ARTICLES	VALUE (Rupees)					
	MONTH OF MAY			2 MONTHS, 1ST APRIL TO 31st MAY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	8,851	3,267	1,112	41,120	34,313	1,112
French Indo-China	6,427	19,195	18,273	64,250	75,088	72,513
Burma ..	15,69,950	16,74,579	17,87,606	33,43,742	34,16,556	32,57,887
Java ..	37,346	66,214	42,789	63,351	73,735	98,101
Other countries ..	6,786	..	..	42,409	..	..
Total ..	16,29,360	17,63,255	18,49,780	35,54,872	35,99,692	34,29,613
Other than Teak—						
Softwoods ..	88,424	92,132	1,02,944	1,85,789	2,74,439	2,20,053
Matchwoods ..	40,795	72,929	40,317	1,12,237	1,18,663	1,42,104
Unspecified (value)	2,31,356	2,88,705	3,01,053	4,33,356	5,95,704	4,83,095
Firewood ..	1,903	479	495	2,442	1,403	600
Sandalwood ..	..	2,919	4,925	1,651	3,603	5,884
Total ..	3,62,478	4,57,164	4,49,734	7,35,475	9,93,812	8,52,036
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	12,016	3,589	9,763	12,016	14,020	15,885
Plywood (tons) ..	1,00,093	86,699	1,21,932	2,70,065	2,12,375	2,13,518
Other manufactures of wood (value) ..	1,51,453	1,21,820	1,06,561	3,29,169	2,77,704	2,40,988
Total ..	2,63,562	2,12,108	2,38,256	6,11,250	5,04,099	4,70,391
Total value of Wood and Timber ..	22,55,400	24,32,527	25,37,770	49,01,597	50,97,603	47,52,040
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	97,226	3,91,857	83,395	2,29,027	6,42,602	2,56,442

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF MAY			2 MONTHS, 1ST APRIL TO 1ST MAY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	1	..	10	23	..	20
,, Germany ..	..	..	..	..	1	..
,, Iraq ..	20	..	4	64	55	12
,, Ceylon ..	..	1	5	..	1	5
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	41	132	104	91	256	384
Total ..	62	133	123	178	313	421
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	3	..	..
Unspecified (value)	..	..	..	..	..	..
Firewood ..	..	..	..	115	..	..
Total ..	..	..	..	118	..	..
Sandalwood—						
To United Kingdom	1	..	..	2	..	51
,, Japan ..	..	2	21	1	4	5
,, United States of America ..	..	10	..	60	85	..
,, Other countries	54	15	25	90	28	57
Total ..	55	27	46	153	117	113
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	..	..	..	..	..	..
Total volume of Wood and Timber ..	117	160	169	449	430	534
Other Products of Wood and Timber	No data			No data		

EXPORTS

ARTICLES	VALUE (RUPEES)					
	MONTH OF MAY			2 MONTHS, 1ST APRIL TO 1ST MAY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	350	..	1,250	3,162	..	2,500
,, Germany ..	..	..	..	..	150	..
,, Iraq ..	4,532	..	847	13,164	18,227	3,073
,, Ceylon ..	..	50	420	..	109	420
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	12,527	44,396	16,927	22,232	71,993	54,217
Total ..	17,409	44,446	19,444	38,558	90,479	60,210
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	840	..	..
Unspecified (value)	4,02,475	30,160	42,584	5,69,633	55,930	58,946
Firewood ..	..	..	..	1,027	..	..
Total ..	4,02,475	30,160	42,584	5,71,500	55,930	58,946
Sandalwood—						
To United Kingdom	1,800	..	..	2,600	..	..
,, Japan ..	..	2,150	22,995	600	3,973	54,025
,, United States of America ..	..	12,000	..	58,040	92,000	5,000
,, Other countries	57,330	16,785	22,200	95,037	31,772	56,797
Total ..	59,130	30,935	45,195	1,56,277	1,27,745	1,15,822
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	19,303	24,280	25,986	30,688	41,380	59,946
Total value of Wood and Timber ..	4,98,317	1,29,821	1,33,209	7,97,023	3,15,534	2,94,924
Other Products of Wood and Timber	No data			No data		

INDIAN FORESTER

SEPTEMBER 1939

THE FUTURE OF THE "INDIAN FORESTER"

In the May number of the *Indian Forester*, a statement was given in the Editorial Notes of the journal's finances during the year 1938, in which attention was invited to the serious decrease in subscriptions and an appeal made for extended support.

During the past five months a special effort has been made, by more numerous illustrations and an increased volume of printed matter, to make the journal more interesting and attractive. Whether this attempt will have proved sufficiently successful to result in increased support is not yet known. The practical appeal which has thus been tried will, however, of necessity be reinforced and endorsed by an unavoidable contrast. In order to finance this special effort a dormant period for the remainder of the year is inevitable and for the next few months the issues will be lean in size and almost devoid of illustrations. It is hoped that this contrast may bring home, to all those who are interested in forestry in this country, the difference which a little extra support can make to the oldest journal devoted to the affairs of forestry in India, which, ever since its foundation in 1875, has played its small part to the best of its ability; and, moreover, may convince them that such additional support is worth while.

This trial enlargement of the journal represents a requirement of an extra income of about one thousand rupees annually before it could be made permanent. In 1938 the *Indian Forester's* total income was, in round figures, nine thousand rupees. Expenditure in 1938 was eight thousand five hundred rupees, made up of five thousand for printing, one thousand three hundred for illustrations, one thousand for postage and one thousand two hundred for cost of management. The last item is subject to little reduction, consisting

as it does only of a fixed percentage on income to the publishers and a monthly salary for a single clerk. As an offset against this there is a small income from investments of rather less than five hundred rupees.

It will be seen from the above that the average cost in 1938 for the printing and illustrating of each issue was five hundred and twenty-five rupees. The cost for these items in a representative number during the first half of this year has been six hundred rupees: not a large increase on the month's expenditure, but quite enough to create a financial crisis if support from subscribers deteriorates in any such serious manner as was the case in 1938.

Foresters as a class are not wealthy, but a year's subscription does not amount to a large sum and a hundred extra subscriptions would make a vast difference. What, however, particularly seem to be needed are donations, which would allow the accumulation of sufficient capital to meet the ordinary cost of management. With a capital fund producing a regular income of twelve to fifteen hundred rupees, subscriptions each year could be devoted entirely to the actual journal and the quality of the production vary in consequence in direct proportion to the current degree of support. Life subscription for a forest officer on retirement costs only one hundred rupees. If any one still serving would like to take time by the forelock and subscribe his hundred now, a careful record will be kept to continue to send him his monthly copy from whatever date he may actually retire. All donations and advance life subscriptions will be put to capital account. Already about one-third of the required capital sum has been laboriously built up by small savings carefully accumulated in the past.

Continuity is the watchword of forestry. We did not ourselves grow the forests in which we work and the results of our own work can only be fully appreciated long after we are dead. As a whole, therefore, all work in the forest is a collective and anonymous work. The background of Indian forestry is full of meritorious achievements. Its foreground is densely dotted with promising possibilities. The *Indian Forester* forms a principal link between present, past and future. Should we not all do what lies within our power to insure its continuance and improvement?

ROTATIONAL GRAZING IN THE BOMBAY FORESTS

BY R. P. DALLEY

In connection with Mr. Sagreiya's instructive article on "Making better grazing available in open pasture forests," the proposals included in the revised Working Plan for the West Khandesh Division of Bombay may be of interest. This plan was written by Mr. E. A. Garland and his proposals, which are very similar to those suggested by Mr. Sagreiya in his (*b*) scheme, have just received the approval of the Revenue authorities and of the Chief Conservator of Forests. An attempt is to be made during the current monsoon season to give effect to the proposals on a limited scale as there has not been time to lay out on the ground all the pastures and ranches proposed for the whole area. Only about one-eighth of the number of ranches will be laid out by June 15th on which date the new closures will begin.

Special importance attaches to this experiment because the principles underlying the grazing proposals are the same as those which have been embodied in the proposed new grazing rules for the Province, which were also drafted by Mr. Garland. These rules have been widely circulated in the regional languages so that any objections to them put forward by the public can be given due consideration. They were published in the July issue of the *Indian Forester.*

The revised West Khandesh Plan is not the first Bombay Working Plan to include a rotational grazing scheme. Mr. Pereira's Plan for a part of East Khandesh Division contains this feature, and has been in force for over ten years. But even before this it was recognised by the Bombay Government that rotational grazing and the limitation of cattle were necessary for the improvement of pasture areas. A reference to articles 135 to 137 of the *Bombay Forest Manual,* Vol. II, will prove this. In the scheme laid down for the pastures handed over to village *panchayats* in the West Khandesh Division it was prescribed that each area was to be divided into three blocks, one of which was to be opened to grazing all the year, a second was to be opened from 1st October and the third from 1st

April. On 1st June the scheme began again but the blocks were changed round, so that after three years each block had in turn been opened to grazing for the three different periods. These rules were drawn up in 1911 but it seems that the *panchayats* were not able to work them successfully.

A still earlier reference to rotational grazing is to be found in Article 429 of Volume II of the Manual. This dates back to 1885 but it relates only to the grazing of sheep in reserved forests. This scheme was recently in force in a part of the Sakri Range where a large number of sheep are grazed by professional graziers. This scheme merely consisted of a division, into three blocks, of the area to be grazed, each block in turn being opened for three years and closed for six years.

In East Khandesh a rotational scheme was applied to the Scrub areas south of the Tapti. This area was divided up into convenient blocks and in most blocks a portion containing good soil was set aside as a permanent "*kuran*" for grass cutting purposes in which grazing was to be allowed in the hot weather only. The remaining area of each block was divided up into five sub-blocks for rotational grazing purposes. Provision was also made for felling the tree-growth on a 20-year cycle by dividing each sub-block into four coupes. The sequence of coupes was arranged so that sub-block (*i*) contained Coupes Nos. 1, 6, 11 and 16; sub-block (*ii*) Coupes 2, 7, 12 and 17 and so on, so that the coupe being felled would always be in the sub-block receiving the longest continuous closure, which amounted only to 14 months (1st September of one year to 31st October of the following year).

The arrangement laid down for closure was as follows. In the first year sub-blocks (*i*), (*ii*) and (*iii*) were opened to grazing from June 15th and (*iv*) and (*v*) were kept closed. On September 1st, after $2\frac{1}{2}$ months' closure, sub-block (*iv*) was opened and sub-block (*i*) (containing Coupe No. 1 to be felled) was closed. On November 1st, after $4\frac{1}{2}$ months' closure, sub-block (*v*) was opened, *i.e.*, after the grass had seeded. In the following year the same procedure was repeated but with different sub-blocks. Thus from 15th June (*ii*), (*iii*) and (*iv*) were kept open while (*i*) (with last year's felled coupe) and (*v*) (where grass had seeded) were kept closed. On September

1st (*v*) was opened and (*ii*) (with Coupe No. 2 to be felled) was closed. On November 1st (*i*) was opened.

The scheme laid down by Mr. Garland for West Khandesh differs from the above and a different nomenclature has been introduced. The blocks are called "ranches" and the sub-blocks "pastures," in order to prevent confusion with the generally accepted forestry definition of a "block." Each ranch is divided into five pastures but the pastures are not further sub-divided into coupes. Each pasture actually constitutes a coupe. A felling cycle of 40 years has been adopted so that a felling series consists of eight ranches (A to H). Ranch A contains Coupes 1, 9, 17, 25 and 33; Ranch B Coupes 2, 10, 18, 26 and 34 and so on.

The system of closure adopted is as follows. Each coupe will receive eight years' continuous closure after felling. Grass-cutting, but no grazing, will be permitted in the pasture which corresponds to the closed coupe. From the arangement of the coupes it will be seen that there will not be more than one such closed coupe in any ranch at a time. The treatment to be given to the remaining four coupes or pastures in a ranch will be as follows. One pasture will be kept open for 12 months and the other three will be grazed in turn during the monsoon period—15th June to 31st October. Each of the latter will thus be open for one-and-a-half months and closed for three months during this period.

Each year there will be a change in the arrangement of the four pastures. The pasture in which grass has seeded will be the one to receive closure for three months at the beginning of the next monsoon season. During the dry season—1st November to 14th June—four pastures will be open to grazing. A subsidiary reason for keeping one pasture open throughout the year is that privileges enjoyed by the wild tribes for free collection of grass, dead-wood, etc., can be exercised in that pasture without hindrance or confusion.

In comparing the two arrangements described above, it will be seen that in both cases provision has been made for the production and maintenance of tree growth as well as of grass. In East Khandesh the felling cycle is 20 years and the closure only 14 months. It was thought that this would be sufficient for coppice and seedling growth of thorny species like *Acacia catechu, Acacia arabica* and *Zizyphus jujuba* which predominate over the area. *Hardwickia*

binata, *Anogeissus latifolia* and *Boswellia serrata* are also common in certain localities, whereas teak is the main species in one range. There is no doubt that fire protection is completely achieved by this method except in the grass *kurans* where fires do occur, but where no attempt is made to do any artificial regeneration. The Divisional Forest Officer, Working Plans, has recently inspected the area and is of the opinion that the natural regeneration of the non-thorny species has not suffered as a result of the grazing arrangements and in fact is good in the case of *Anogeissus latifolia*. Even *Hardwickia binata* seedlings have established themselves in areas which are constantly open to grazing. In the West Khandesh plan it has been decided, however, to give eight years' continuous closure for the thorough renovation of each coupe. The object is not merely to allow such species to come up as may be self-sown. On the contrary, such portions of the coupe as are fit for it will be put under temporary cultivation (*taungya*) and stump-planting of the species, previously raised in special nurseries, will be done in lines along the contours. This work will be combined with both terracing and contour trenching and it is hoped that this organised work under official control will prove attractive and also beneficial for the very numerous and landless *Bhils*—a very backward tribe found in large numbers throughout Khandesh.

In regard to the grazing arrangements, it will be seen that the main difference between the two schemes is that in East Khandesh three-fifths of the area is open at a time during the monsoon and there is only one change-over (on September 1st). In West Khandesh only two-fifths of the area will be open at a time and there will be two changes-over during the monsoon (on August 1st and September 15th). It has yet to be seen whether this more complicated system can be successfully enforced. Everything, of course, depends on the co-operation of the villagers. This is really the crux of the whole problem as Mr. Sagreiya has recognised. In this connection an enquiry was carried out by Mr. Garland as to whether the villagers would assume responsibility for the closure arrangements. Only one village agreed to try. The remainder, though welcoming the proposals, said that there were always party factions in the villages so that it would not be possible for them to succeed in keeping the correct areas closed without the help of the Forest Department. I

think it may be possible to get the full co-operation of the villagers if they can first be persuaded that the scheme will result in benefit to their animals and provided that results are regularly assessed by means of periodic inspections by the Forest officials. In East Khandesh the closures have not always been properly enforced as everything has depended on the honesty of the forest subordinates whose work has not been made easy by the fact that the cattle of first offenders may not be impounded. This latter is an arrangement which will probably have to be changed as it is certainly being abused. If the villages can be made to assume communal responsibility by means of some definite concrete benefit (some reward or even perhaps by being permitted to recover grazing fees for public use) then alone there will be a chance of really successful protection.

I have not mentioned the most important feature of Mr. Garland's new working plan and of his proposed grazing rules, namely, the question of how the very necessary limitation of the number of animals that may be admitted to graze in a particular ranch should be fixed. Without successful restriction in this respect, over-grazing, with consequent deterioration both of the animals and of the pasture areas, is bound to take place in the more populated localities. This deterioration has, of course, already taken place. All the hilly forest areas which are being heavily grazed (especially those in charge of the Revenue Department) are now so completely eroded that they are little more than bare rocks.

The method of fixing the maximum number of animals that may be admitted to graze in a particular ranch has been based on the assumption that each animal will need at least two acres of grazing area. This figure is undoubtedly a low one. The next question to be decided was which animals were to be excluded in the event of there not being enough pasture area to accommodate all the village animals on this scale. For this purpose it has been decided that the basis of calculation should be the actual area which has been cultivated in the villages concerned, and that a certain number of animals should be regarded as "essential" for a given number of acres cultivated. The figure given by the Director of Agriculture was that one animal should be considered as "essential" for every five acres of cultivation. Mr. Garland has taken a more

liberal figure and allowed one animal for every three acres of cultivation in Sakri *Taluka* and one for every four acres in Dhulia *Taluka*. Sakri is a much poorer area and due to climatic reasons the cattle are smaller. Mr. Garland found that, as it happened, these figures also roughly corresponded to the actual number of animals existing in the district in villages sufficiently adjacent to the forests to use the grazing, so that it is apparent that practically all existing village animals will be counted as "essential."

On this basis it was found that practically all these animals could be accommodated in the grazing areas within reach of the villages, on the basis of two acres of pasture for each animal. Out of about 69,000 "essential" animals, there was no provision within reach of the villages for about 2,000 animals. Under the proposed grazing rules, any "non-essential" cattle will not be allowed to go to the ranches allotted to "essential" cattle; they will have to be sent to what will be known as "public" ranches. In forming the ranches, compromises had always to be adopted, because the pastures correspond to annual coupes for exploitation of tree growth and consequently require to be reasonably equal in size. This presented a good deal of difficulty because one village with a small amount of cultivation would often adjoin a large village with much cultivation, as a consequence of which the first would require only a small ranch (with five roughly equal-sized pastures) for its essential cattle, while the second village would require much larger pastures. In certain cases, therefore, it was unavoidable to group small villages to a joint ranch in order that the eight ranches required to comprise each felling series might be reasonably equal in size. After the requisite areas had been allotted to all entitled villages for their essential cattle, residual areas in the interior were similarly divided into ranches which will be made available for the cattle and sheep of wandering professional graziers as well as for extra cattle owned by villagers in excess of those which can be classified as "essential." These cattle ranches have been called "Public" to distinguish them from those which have been allotted for the use of the cattle of particular villages.

There is another side to this question of the number of animals that should be regarded as "essential." If the cultivator is doing his own cattle-breeding, then he must maintain many more animals.

The Live-Stock Expert to the Government of Bombay considers that for each pair of bullocks an agriculturist who does his own breeding should be allowed an additional seven or eight animals. If he buys his stock and does not do his own breeding then an additional two or three animals will suffice as milch animals and young stock. These figures appear perhaps to be on the high side. Of course, the acreage which can normally be cultivated by a pair of working bullocks must vary considerably from place to place, in accordance with the nature of the soil and size and quality of the bullocks. In Khandesh the cultivators do not usually breed their own animals but purchase them from the herds belonging to wandering professional graziers and breeders. Assuming, however, that, on an average, four extra animals are required to each pair of working bullocks in Dhulia *taluka,* the figure of four acres of cultivation per head of essential cattle would mean that there would be a pair of bullocks to every 24 acres under cultivation. Similarly, if six extra animals are required in Sakri *taluka,* the figure of three acres of cultivation there per head of essential cattle would also allow one pair of bullocks to every 24 acres. This appears reasonable, when consideration is also given to the fact that dry cows and young stock not ready for work can always be sent off to the nearest public ranch until they are required nearer home. In this way, a steady flow could be arranged by each cultivator whereby some of his young and dry stock were always out in the public ranch and thereby one or two extra working bullocks or cows in milk could be kept at the allotted ranch for essential cattle.

It is not possible for me to discuss in this article the various questions and difficulties which may be expected under the above scheme. I must also refrain from considering possible alternatives that may have to be adopted to get over difficulties. The question as to whether the proposed grazing rules should be applied to the high forest areas in Kanara or to the moister areas in Kolaba and Thana is also one that is under consideration. All these questions must be left for future discussion in the light of such experience as may be gained during the next month or two in West Khandesh. It is good news that the Central Provinces are also taking up this question. The improvement of pasture areas is an urgent necessity to which attention must be directed in every way possible.

GROWING SISSOO IN SAL SOIL

BY S. H. HOWARD.

Two statements that have appeared recently in reports are: "I should *never* put it (*sissu*) on a sal soil (except as a temporary nurse)" and "I do not know a single case of a really good quality *sissu* crop on a *sal* soil." These two statements were not written for publication, but they were written by two men whom I consider to be two of the best silviculturists I have known in my service, and naturally such an opinion from them carries great weight.

I believe these statements, expressed generally like that, are incorrect and misleading.

There are plenty of areas where excellent *sal* is growing, and where nobody would dream of putting in *sissu*; in fact if the *sal* is really vigorous, *sissu* cannot hold its own against it eventually, *e.g.*, Amery's plantation in Gorakhpur, though there may have been other reasons for that. But there are areas where *sissu* might well help to solve a difficult problem if this idea that *sissu* will not grow on *sal* soil could be modified.

Below are examples of *sissu* growing healthily on *sal* soils. It will be noticed that some of these have ceased to be *sal* soils for a considerable time and that all the examples come from plains *sal* forests:

1. Many fine trees in roadside avenues on areas which probably once were *sal* forest.
2. A fine avenue between Sohelwa Forest and Bhinga Forest. The trees are misshapen, like so many roadside trees, and are now very old and hollow, but there is no question of their original vigour.
3. Many fine mature *sissu* plantations on the old grantees' estates and railway yards in the Gorakhpur District, which were certainly *sal* forests seventy or eighty years ago.
4. A fine mature *sissu* plantation which I saw felled about 20 years ago some two miles above Madhaulia Resthouse in the Gorakhpur Division.

5. Some healthy *sissu* growing with *sal* in the compound of Abdullapur Resthouse in Bahraich Division.

6. In Dhaniapur *sal chandar* of South Kheri some very good *sissu* about 10 years old, already 8—10 inches in diameter and 50 feet or so high. This has *sal* all round it and underneath it. The only reason the *sal* does not come up in the *chandar* is because of frost, but underneath the *sissu* it is now coming up beautifully. I think the *sal* here would oust the *sissu*, but there seems no doubt the *sissu could* be grown.

7. On a fire-line in a *sal* forest near Kishenpur, there is a good, healthy crop of *sissu* about ten years old, 8—10 inches in diameter and a good 50 feet high. On the same fire-line a little further from the resthouse is a plantation which might well be taken as an example to prove that *sissu* will not grow on a *sal* soil, but I remember it when it was started, and used it in the Pocket Book as an example of how not to grow *sissu*. But it was the work which was wrong—not the soil, and, moreover, it has been annually burnt ever since, so it has never had a chance.

8. A *taungya* area made after felling *sal* near Gulra in Bahraich, where the growth is splendid though it is only two years old. It actually looks very bad and may later be quoted as an example of *sissu* not growing well on a *sal* soil, but the reason is obvious at present as it is terribly damaged by *nilgai* and monkeys.

9. A similar area near Kakardari in Bahraich which, for some reason, monkeys and *nilgai* have so far left alone. It is only two years old, but must be 15 feet or more in height.

10. Any number of similar areas in Bahraich and one or two in South Kheri up to about five years old. These are often terribly damaged by monkeys, but the growth is healthy enough. Admittedly, areas only a few years old are not much to go by, except that there are examples of older crops.

I suggest that the real truth is that—

(*a*) There are soils where *sal* will grow well and healthily but which are unsuitable for *sissu*.

(*b*) There are soils where both grow perfectly well.

(*c*) There are soils where *sissu* will grow well and *sal* would not grow well.

Finally, I suggest that it might be better to stop all mention of *sal* when deciding whether an area is suitable for *sissu* or not. Nobody says that you cannot grow *sal* on a *dhak* soil, though it is probably just as correct as to say you cannot grow *sissu* on a *sal* soil. You simply judge that one area is probably suitable for *sal* and another is not, without any reference to other species, though their presence or absence probably helps to form your judgment. Equally, if I see a fine, deep, rich, moist and rather heavy loam with first quality *sal* on it, I should not judge it as suitable for *sissu*, but it is not because *sal* is growing, but because it is a fine, rich, moist, rather heavy loam.

A NOTE ON FERULA FOETIDA

[SYN. *FERULA ASAFOETIDA*: COMMERCIAL NAME *HING*.]

BY KHAN SAHIB HAFEEZ-UD-DIN, FOREST OFFICER, BALUCHISTAN.

The *Hing* plant grows on the rocky and arid hills of Western Baluchistan and also in Kharan, Kalat State, Kabul and Iran territories.

In Baluchistan it is found growing in the Chagai District on Amlop, Zarat Balanosh, Malik Naro, Malik Siah Koh hills, Roeo, Panezai, Seh Shaman, Gaze, Koh-i-Sultan (from Omai to Saindak), Mazan-Wad, Bagh and in some places towards Piran and Robat.

The hills are almost treeless and bare, the only sign of vegetation during winter months being the remains of a few shrubs scarcely one foot high. Poor specimens of *Haloxylon ammodendron, Stocksia brahuica, Ephedra* (thick), *Tamarix* species, *Artemisia, Haloxylon salicornicum, Senecio coronopifolius, Pistacia khinjuk* and *Ficus carica* are found growing sparingly in the beds of dry ravines or along their edges. Rainfall is scanty and there are only

Hing collector of Koh-i-Sultan, with *Dol* in one hand and *Ishkar* in other, going to remove *Hing* from the crown of *Hing* plants in *Kundak*.

Making *Kundak*.
(*Hing* collector with *Tesha*) in Mazan Wad (*Kecho*).

a few salty springs. Strong winds, from Kabul side, carrying sand, blow over the area.

The *Hing* collectors who wander in these barren hills are poor folk. They have no regular houses but live in small, ill-made *jhuggis* (huts). All the same, they are by now sufficiently trained for the *Hing*-collecting operations; moreover, they are fully aware of the benefits they can derive therefrom.

The *Hing* plant is a herb with a circular mass of foliage which may spread over the ground to the extent of two to four feet in diameter. It springs up annually from a perennial root-stock or underground stem. Leaves come up annually at the beginning of spring (March-April). The flowering stock (inflorescence), or *Kular* —as it is locally termed—shoots up pillar-like two feet to three feet high and one inch to two inches in diameter. Only one to ten per cent. of the *Hing* plants bear flowering stock. The percentage of *Kular*-bearing plants varies according to rainfall. The diameter of the crown of the underground stem or the tapping point is seldom more than two inches. The leaves and flowers ripen in May-June. Plants having inflorescence are said to contain no *Hing* juice and are not tapped. As a rule, only the well-developed plants give out the flowering shoot. If the inflorescence or flowering stock be not allowed to develop, the root-stock is bound to yield *Hing*, but this has never been tried by the locals.

The tapping operations are started with the ripening of leaves and are continued up to September.

The root-stock gets exhausted after tapping. It is stated that a *Hing* plant (if it is permitted to make its full growth and is not much damaged by grazing) becomes fit for tapping after seven years. But these areas are grazed over and only about fifty per cent. of the plants give *Hing* juice when tapped after six or seven years.

The locals now work out an area after six years. A man can collect only about fifteen to twenty seers now in one season as against forty seers previously.

Another economic product of these hills is a white substance called "*pul-mak*," which is the mixture of Sulphate of Alumina and Kaolin (China Clay). After purification the former is used as a mordant in carpet dyes which are necessarily of fast shades. It gets deposited along the banks of saltish spring-water. It is a valuable

economic product and its yield can be increased if the water containing this substance is dried in pans (cisterns) made of cement.

The area once worked becomes fit for *Hing*-tapping after an interval of seven or eight years. The later the better, as the yield is greater. The locals know when the areas containing *"janakee"* (*Hing*)—as they call it—are fit for tapping. They join in parties of five to ten and try to protect the area when the *Hing* plant sprouts in early spring. But in the absence of any rules they cannot achieve the desired end. A fair proportion of *Hing* crop is always grazed over by the flocks of those who are not interested in the collection of *Hing*. The party of collectors under the present circumstances can save only a percentage of the *Hing* crop. The collection work which is a laborious task becomes more so and the total quantity of the seasonal collection falls.

As soon as the leaves begin to ripen in May, the party of collectors starts putting stones on one of the leaves of each plant to be tapped, as a mark. This operation is called *Putgal*. Strong winds sweep over these bare hills and if this is not done, the dried leaves are blown away and it then becomes difficult to mark the existence of the underground stem. When this is complete, they commence digging small pits round each plant with a small pickaxe-like implement called *Tesha*. These pits are about one foot in diameter at the top and six inches at the base and four inches to six inches deep from the ground level or the junction of the root-stock and leaves, *i.e.*, crown. In other words, about four to six inches of underground stem is exposed. A small hut-like covering of stones is made over the pit on the exposed part of the root-stock. These constructions generally face towards the north and care is taken that the exposed root-stock is not exposed to the direct rays of the sun. A small stone is also placed against the opening of this small *jhuggi*-like construction, locally termed *Kundak*, so that the exuded *Hing*-juice is not spoiled by the sand which is carried by the strong winds which continue blowing during these months.

The party in its third round removes the dried sheaths of fallen leaves from the crown of the underground stems. This operation is termed *Lag*. They then make cuts at the top with a small iron instrument about three inches long and $2\frac{1}{4}$ inches wide (blade) called *Ishkar*. The act of giving the first cut is termed *Kisht*. The *Hing*

fluid, *i.e., Sheera*—or *Hing-engoza* as it is locally termed—then begins to flow. After the *Kisht* the area is divided among the members of the party. *Kisht* work which can be done during five days is given to each member.

The collector, with a small bag of uncured goat-skin called *Dul* or *Doal* in one hand and his *Ishkar* in the other, visits every *Kundak* regularly after every five or six days. He removes the *Sheera* (exuded juice) with his *Ishkar* from the crown, puts it in the *Doal* and makes a fresh cut. During the collection period, which extends up to three months, the collectors go over the area about fifteen times, each time making a fresh cut after collecting the *Sheera*. This whole operation is termed *Torchal*.

It is said that about 50 per cent. of the root-stocks after the *Kisht* begin to yield *Sheera*. It is not possible to form any definite opinion as to why 50 per cent. of the plants give no—or very little—*Hing*. I think it may be due to under-development of *Hing* plants due to grazing. This defect, it is hoped, can considerably be removed if the *Hing*-yielding areas are protected from grazing one year before and after the working year. In this way, not only the unnecessary labour of making *Kundak* will be saved, but the yield, too, will increase.

From the *Doal*, or small leather bag, the *Sheera* or drug is put in a goat-skin called *Post*. As already stated, each plant is given fifteen cuts during the season and the yield per plant is only some ounces. As a proposed system of management, the whole range of hills may be divided into *Hing*-growing and grazing blocks. A system of rotational grazing could then be enforced and only right-holders allowed to graze under control. *Hing*-growing areas can yield the drug after seven or eight years. Each area could be divided into seven or eight compartments and worked by rotation.

The seeds germinate and the underground root-stock gives out a flush of leaves early in spring, *i.e.*, March-April, and the plant ripens in May-June. The whole of the *Hing*-growing block may remain closed against grazing from March to June (four months). After that, three blocks, *i.e.*, the areas worked during the last year, those down for the year and to be worked during the ensuing year may remain closed for the whole of the year. The remaining blocks

may be opened for grazing to right-holders only, who are given the adjoining area to be worked during the year.

The grazing blocks or the areas containing less *Hing* should also be divided into compartments or sub-blocks which may be grazed by the right-holders in turn.

In this way, both grasses and *Hing* crop will improve and the locals will get better grazing and collect more *Hing*.

NOTE ON MOHNYIN RESERVE, MYITKYINA DIVISION

By H. B. Barrett

Divisional Forest Officer, Myitkyina Division.

Mohnyin is in the wet zone of Upper Burma. Kadu station, which is in the middle of the reserve, is 24° 44′ north latitude and 96° 17′ east longitude, 628 miles from Rangoon and at a height of 829 feet. The reserve is flat or nearly so. Apart from the monsoon rains, which may last from the middle of May till the end of October —though the showers are not as heavy as in Lower Burma—mists occur up to February and rain is likely in almost any month in the year. As hills rise to 5,000 feet within a few miles of the reserve, storms are frequent. The result is a moist and—for so near the tropics—cold climate. The area of the reserve is 24,270 acres, or nearly 38 square miles, and it is rich in teak.

Though Mohnyin Reserve is rich in teak, it is poor in natural regeneration, few trees under four or five feet in girth being found, the undergrowth being evergreen, which is also invading *indaing*, the forest found on laterite soils in Burma. It is worthy of note that the principal *indaing* species is *ingyin* (*Pentacme suavis*), the *Dipterocarpus, in,* not occurring to any extent in this forest.

Teak's failure to regenerate is ascribed to deciduous forest not being the climax type. I consider that the key to the situation is the political history of this part of Burma in the last couple of centuries. This is my personal view only, put forward as such, and I would be glad of comment.

Mohnyin, apart from a small area in the south-west, lies in the headwaters of the Namyin stream, which flows into the Mogaung river at Mogaung town. The Namyin flows through a fertile plain

about 60 miles long and usually about 10 miles wide, bounded on each side by a mountain range running up to several thousand feet. The population even now are largely Shan-Chinese. This tract, isolated from the south, was ruled by Shan *Sawbwas* with their capital at Mogaung or Mohnyin, usually Mogaung, and holding under the Viceroy of Yunnan. The valley seems to have been densely populated; Mr. T. R. Shortis, of the Burma Sugar Company, Sahmaw, when inspecting clearing for sugarcane growing, traced the line of the old Mogaung City which runs for miles. In the middle of the eighteenth century the Burmese under King Alaungpaya overcame the Mons and began to expand northwards. Shan Sawbwas lingered until 1798, but the King of Burma had replaced the Chinese Viceroy some time before that. But some of the Burmese kings, in particular Bodawpaya and Bagyidaw, were men of war and conquered Arakan and Assam. At this time the Kachins were pressing down, and Burma, weakened by numerous wars, was not able to reduce them effectively. The old Shan State in the plain relapsed largely from fields to forests, the Kachins, who practise shifting cultivation, keeping to the hills. About 50 years ago the British arrived in the valley, and the arrival of the railway and restoration of order resulted in the clearing of the plain again. Now if one looks at the valley from any height—although most of it is covered with a dense mist in the morning—"islands" appear here and there. These are forested areas. Mohnyin forest at the end of the valley is not, as a rule, covered with mist. This, I think, does establish the theory that the clearing of forests for cultivation results in mists therein. Even if the mists do not reach far into the forests, they must make the surrounding air colder and moister. The process of clearing the floor of the valley coincided with reservation at the upper end and along the sides, thus checking shifting cultivation by the Kachins. In addition, fire-protection was practised for a considerable time. All this favoured evergeen as against deciduous forest.

We may now glance briefly at the past history of Mohnyin Reserve.

Constitution.—The reserve was constituted under Revenue Department Notification No. 378, dated 6th October 1893. A few subsequent notifications have only made petty changes in the area.

B

Past Management.—A rough fifteen-year working plan for teak, based on linear enumeration surveys of 5.9 per cent. of the area, came into force in 1895-96. This plan prescribed a normal yield of 1,285 girdlings a year, but fixed a maximum of 1,500 a year, as there were many mature trees. The whole reserve was divided into three five-year blocks. Girdling officers proved cautious, and at the end of the period only 13,160 trees had been girdled against 22,500 prescribed. It is stated in the next working plan that the girdling officers feared to open the canopy too much. During this period many experiments with artificial and natural regeneration were made. Plantations proved too expensive owing to weeding costs. Natural regeneration was tried by the following methods from 1898 onwards:

(1) Burning only. No success.

(2) Clearing and sweeping or burning small plots. Seedlings appeared in large numbers but were damped off by drip from big trees.

(3) Clearing and burning large plots. Many seedlings came up but were choked by grass and weeds.

(4) Clearing and weeding. Successful.

(5) Draining and clearing. Successful.

Fire-protection was successful for the last ten years of this plan, and climber cutting was done. In 1910-11 another plan for 20 years came into force, based on a preliminary working plan report by Mr. Beadon-Bryant, then Chief Conservator of Forests, Burma, and later Inspector-General of Forests. This plan proposed to treat the forest under the regular method with the object of converting it into a series of even-aged woods in one rotation of 180 years, the ultimate object being to produce big teak of Europe-square quality. The forest was divided into nine twenty-year blocks. One was to be the regeneration block, in which all teak was to be girdled except compact groups of sound teak under 4 feet 6 inches in girth, and all trees of other species were to be felled. Over the remaining eight blocks selection girdling, with the object of removing mature and over-mature teak, was prescribed, subject to the proviso that teak under 10 feet in girth might be girdled only if obviously deteriorat-

ing. Blocks were allotted to years, and all were to be worked over in 20 years.

Subsidiary Operations.—Climber cuttings, cleanings and thinnings were prescribed, also fire-protection where necessary; the area to be regenerated being protected until the regeneration felling had been made and then burnt. This would be three years after girdling.

This plan was revised in 1920-21 by the Silviculturist, Mr. Blanford. It was found that the growth was faster than had been estimated by Mr. Blanford when preparing the 1910-11 plan, and as the teak was not as good as that in the best forests in Burma, it was decided to stop growing big trees and the rotation was reduced to 100 years to correspond with a seven-foot girth.

Regeneration.—It was decided that planting was much better than natural regeneration, as the latter method needed many seed-bearers and produced an uneven result. The plan prescribed that exploitation of all marketable timber must precede regeneration, and the full regeneration area must be regenerated by the best means, to be devised by the Divisional Forest Officer. Experiments were to be carried out with other species, *Yemane* (*Gmelina arborea*) being emphasised. The forest was divided into two felling series; approximately 75 acres a year were to be worked over in each, under regeneration girdlings. Outside the regeneration block selection girdlings to remove mature and deteriorating trees were to be done. No girth-limit was fixed but no tree likely to survive 20 years was to be girdled. The girdlings were divided into two five-year sub-periodic blocks yielding $4{,}200 \times 5 = 21{,}000$ square feet of basal area. If regeneration girdlings exceeded 4,200 square feet of basal area in a year, they were to be reduced by the excess in the following year. If they fell short, selection girdling for the balance was to be done. Fire-protection for certain compartments and also during the early years of plantations was prescribed—also weedings, thinnings and cleaning, climber cutting and *nyaungbat* fellings. Improvement fellings were dropped except in fuel-producing areas.

Girdlings under this plan were:

	Trees.
Selection	2,331
Regeneration	12,692

Actually regeneration was all by *taungya* and the following areas were made:

				Acres.
Pure teak	...	...	...	170
Teak and *yemane*	...	...	...	9
Yemane and *yinma*	...	...	...	6
Yemane	...	...	...	18
Yinma	...	...	...	2
Hnaw	...	...	...	2
Miscellaneous	...	...	...	6
Pyinkado	...	...	...	2
		Total	...	215

None of the plantations except teak and *Pyinkado* have been successful. The *yemane* is all either dead or so heavily infested with *loranthus* as to be moribund.

This plan was replaced by another for 10 years from 1931-32 drawn up by Mr. E. W. Carroll for the whole of Myitkyina Division. In this, Mohnyin Reserve is included in Felling Series III.

Under this plan, Mohnyin Reserve falls into two working circles:

(*a*) The Teak Selection Working Circle, which contains most of the teak-bearing forests of the division, and in which Mohnyin, with the small Bilumyo Reserve, forms Felling Series III.

(*b*) The Regeneration Working Circle, of which Mohnyin contains Felling Series VI and VII.

Selection.—The yield is prescribed as 600 trees seven feet and over a year. Girdling for convenience of working is carried out until a suitable boundary is reached, differences being adjusted from year to year. Under orders from the Chief Conservator over-mature trees are girdled whether marketable or not, also trees under the girth-limit, the removal of which is justifiable for silvicultural reasons. Girth-limits at 4 feet 6 inches are 7 feet 6 inches in moist forest and 6 feet 6 inches in dry. This yield has, so far, worked out very well.

Regeneration.—It was prescribed that regeneration be carried out by the *taungya* method, all marketable timber being first disposed of. As far as Mohnyin was concerned, regeneration was to

continue in Felling Series VII at the rate of 30 acres a year. Actually it was not possible to work up to this, and 14 acres were regenerated in 1931 and 12 acres in 1932. Government decided that plantations should be much reduced in Burma, and planting in this reserve was then stopped.

This plan gives detailed instructions for tending of plantations. The position now is that the following areas, excluding areas written off, remain:

	Acres	Cost	Cost per acre
		Rs.	Rs.
Natural Regeneration	81	102	1.26
Artificial Regeneration	246	4,956	20·15
TOTAL ..	327	5,058	18·53

Rupees two hundred and ninety-seven have so far been received in revenue. It should be borne in mind that—

(*a*) The majority of the plantations are still young and so are only just beginning to reach the remunerative stage.

(*b*) The costs of plantations are mainly in the early ages.

The main differences in tending of tropical as compared with temperate zone species may, I think, be taken to be:

(*a*) Height growth takes place mainly at early ages in tropical but continues fairly steadily in temperate plantations.

(*b*) Weeds are much worse in the tropics but are outdistanced sooner.

(*c*) Thinnings must be made at a much earlier age. Planting distances do not vary much; six by six feet is usual in Burma. Thus the plantations can close up quickly and keep the weeds down, *but* as trees must have more space, thinning usually begins by a removal of about half the stock at the end of five years. One gets heavy thinnings at round about age twenty in temperate zones. As it may illustrate my remarks, I give below a few figures for Class II teak, Nilambur,

and certain temperate zone species, Class I, from Appendix IV of *Schlich's Manual of Forestry*, Volume III. Heights are in feet. I have selected three European light-demanders as teak is a light-demander. Douglas fir is a moderate shade-bearer but is given as its height growth approximates to that of teak:

Species / Age	TEAK		LARCH		DOUGLAS FIR		OAK		SCOTS PINE	
	Height	Trees per acre	Height	Trees per acre	Height	Trees per acre	Height	Trees per acre	Height	Trees per acre
5 ..	30	..	..	..	..	..	..	..	..	..
10 ..	45	325	18	..	24	..	12	..	13	..
20 ..	62	170	40	900	53	..	30	1920	26	..
30 ..	75	115	58	520	78	..	46	820	40	960
40 ..	85	85	71	350	95	..	69	510	51	63)
50 ..	92	65	80	260	110	..	71	320	60	450
60 ..	97	60	87	205	..	..	79	236	67	340

If we compare *annual* height growth in the above periods we get:

Age	Teak	Larch	Douglas fir	Oak	Scots pine
Up to 5 years.	6	..	..	..	..
„ 10 „ ..	4·5	1·8	2·4	1·2	1·3
11 — 20 „ ..	1·7	2·2	2·9	1·8	1·3
21 — 30 , ..	1·3	1·8	2·5	1·6	1·4
31 — 40 „ ..	1·0	1·3	1·7	1·4	1·1
41 — 50 „ ..	0·7	0·9	1·5	1·1	0·9
51 — 60 „ ..	0·5	0·7	..	0·8	0·7

Girths at the various ages are as below in inches:

Age			Teak.	Larch	Douglas fir	Oak	Scots pine
5	..	..	10	..	Not given	..	..
10	..	..	16	..	"	..	..
20	..	..	25·5	16	"	9·6	..
30	..	..	34·0	24	"	17·2	18
40	..	..	41·0	30	"	24·4	25
50	..	..	48·0	36	"	32·8	31
60	..	..	53·0	41	"	39·6	36

Both sets of figures show that growth in temperate zones does not slow up to anything like the extent that it does in the tropics after youth, and that relatively expensive tending is needed at early ages in the tropics.

It might be said that the foregoing notes indicate a good deal of lack of success, but it is not so. Many useful experiments have been made and much useful information has been gained at a very reasonable cost, and the forest is certainly better than it was.

As plantations have stopped, it is necessary to regenerate the forest by natural means. A certain amount of coppice regrowth comes up from girdlings, but nothing like enough. Clearing and burning on a large scale would probably produce plenty of seedlings, but unfortunately it would also result in much *bizat* (*Eupatorium*) known locally as "Jarmany bin" ("bin" = plant) because it appeared during the war. Burning under seed-bearers was tried in the hot weather of 1937 in an experimental plot in Compartment 15, but though seedlings came up they were damped off during the rains. In 1938 drains of a total length of 850 feet were dug at a cost of Rs. 39-12-0 (£2-19-6) and a few seedlings have survived. It is proposed to try planting a few "clump" bamboos this year in the hope that they will induce regeneration. Rain falling on bamboos tends to run down the culms and though teak will persist under them, their shade is enough to keep weeds down and they drain the soil to some extent

Exploitation and Revenue.—Teak is, and must remain, the principal source of revenue. Up to date the system has been to lease the right to work the forest to large lessees—Messrs Steel Brothers at present—for considerable periods. They extract the timber and pay royalty on it at so much per ton of fifty cubic feet. Teak not up to lessees' standard of marketability, thinnings from plantations and other species are removed by petty traders and villagers. The extraction methods are of little scientific interest. Extraction by lessees is by water. Logs are collected in the forest and then as a rule carted to the Namyin and float away during the rains, being assisted on their way by elephants, which start early in the rains and gradually work down to the Irrawaddy. Logs that miss these elephants have a chance of coming out if the rains are plentiful. Petty traders usually despatch timber not sold locally by rail, as an expensive organisation is needed for the long distance to the Irrawaddy. The forest shows a considerable profit. The original working plan estimated a revenue of about Rs. 60,000 (£4,500) a year, and an expenditure of about Rs. 20,000 (£1,500). Salaries have gone up since then, but other expenditure has fallen so that the financial position remains much the same.

General.—I have tried to show that in my opinion:

I.—Mohnyin Reserve was centuries ago probably a dry forest and that the change to the present moist type with evergreen invasion is due to the spread of cultivation, which causes dense mists and prevents drying.

II.—That many experiments have been tried and that, failing plantations, draining without fire-protection is our best way of trying to get back regeneration.

III.—That as tropical forest grows much faster in youth than temperate forest, it needs most attention then and in consequence we should not be frightened at relatively high costs at early ages.

SOIL CATENA SURVEY

By J. N. Sinha,

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Classification of the growing stock into forest types is the foremost problem of the forester for on it have to be based his prescriptions for treatment. Of course, the naked eye can roughly tell the type, but its evidence is no more reliable than the evidence of temperature from touch. Silviculture has, therefore, evolved certain scientific methods of approach. In India, the general index of quality is height of trees. In Finland, they have adopted the undergrowth as the index of quality, irrespective of what the tree growth may be, and the writer's tours in Finland showed him that they are very satisfied with this method. In the writer's opinion this is a much closer approach to the problem of quality determination than that of height, yet it is not the perfect one. For even the undergrowth may sometimes be not because of certain factors, but in spite of them, and in any case it gives no indication of the past or future tendencies of the soil. The existing soil may be in the optimum condition for a particular species of tree, yet it may be in the process of degradation and may turn unsuitable. Or again, the soil may be aggrading and what it does not grow well now may be the best for it in future.

The soil itself is, therefore, the best guide, for the forest is according as the soil is. An analysis of the soil is thus indicated. But laboratory analysis of soil suffers from disabilities inasmuch as the soil in the field is vitally different from the soil in the laboratory. For one thing, the fauna and micro-organisms die in the process of transport to laboratory, and the exact state of moisture content and its distribution cannot be told by the laboratory analyst.

This brings us to the examination of soil in the field as the best means of quality assessment. But obviously it will not do to dig pits at random and examine the soil, hence the method of soil catena survey.

A catena is a definite association of soil sites arranged in topographical sequence. A soil site is defined as being an area which in all features presents similar conditions throughout its extent. The purpose of soil catena survey as part of stock-mapping is to co-relate the vegetation, qualitatively and quantitatively, with the soil and by tracing the development of a particular species on all the soil sites on which it occurs, to discover the optimum conditions which that species demands. Repeating the examination with other species one by one, the best use of each soil site can be determined. It is considered that the prescriptions of a working plan will rest on surer grounds than otherwise if based on a preliminary soil survey. Further, if the catena survey is extended to the neighbouring agricultural land and the soils compared, it is possible to determine the best use of the land as between agriculture and forestry.

A description of a catena survey carried out in the field is given below:

A party of students of the Oxford School of Forestry worked in the High Meadow Woods near the Forest of Dean, England, for the compilation of an instructional working plan under the guidance of Mr. R. Bourne, Lecturer in Forest Management, Oxford University. The writer worked with the party. Mr. Bourne is an exponent of Soil Catena Survey as the basis of any working plan.

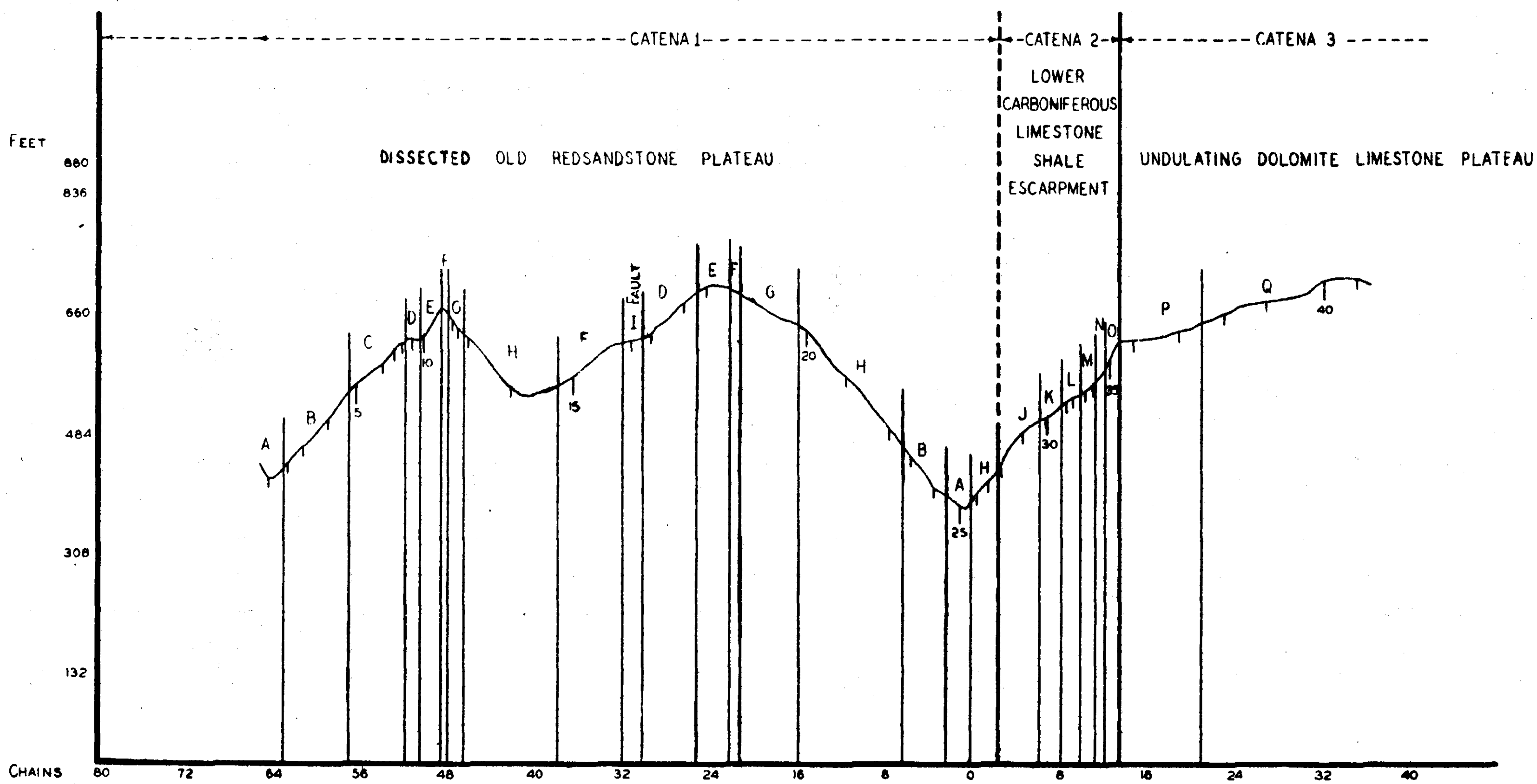
The area under examination ranges in altitude from about 200 feet to 900 feet. Geologically, it extends from the Devonian to the Carboniferous formation. The outcrops vary from Old Red Sandstone on the west to Coal Measures on the east with the Carboniferous limestone in between—a combination which occurs in several parts of England. The higher ground is a relic of an old land surface which, in course of time, was dissected by erosion into valleys and ravines.

The whole area was first reconnoitred in the light of the general features shown by topographical and geological maps. The highest point at Buck Stone, above Staunton, was visited and a view obtained of the old land surface. The main valleys, plateaux and ridges were then traversed.

A

APPENDIX A

PROFILE OF KNOCKALLS LINE
SHOWING CATENA AND SOIL SERIES



NOTE
LETTERS ALONG PROFILE INDICATE SOIL SERIES: NUMBERS ALONG PROFILE INDICATE PITS
MAPPING ON 1"=1MILE CATENA 2 WOULD BE NEGLECTED
IN CATENA 1 SEQUENCE OF SOIL SERIES HAS SOMEWHAT BEEN DISTURBED BY THE FAULT.
IT WOULD LOOK MORE REGULAR IF VALLEY NEAR PIT 15 HAD GONE AS DEEP AS AT PIT 25.

HORIZONTAL SCALE 6"=1 MILE
VERTICAL SCALE 1/4th HORIL.

J. SINHA.
OXFORD. MAY 1937.

As a result of this reconnaissance it was decided to run three level lines across contours so that the principal features of topography and geology would be covered. The lines were run with Abney Level and Trailing Tape and sections in profile were prepared as appended (A).

Soil pits were then dug along these lines at distances of four chains or less if sudden changes in the topography or soil vegetation occurred. Mr. G. R. Clarke of the Soil Science Laboratory, Oxford, who was working with a party of his students in conjunction with the Forestry party, after agreeing with Mr. Bourne on a preliminary classification of the soils—copy appended (B)—undertook the description of a few representative profiles. The appended description (C) is a sample of how the soil in a pit and all the features connected with that soil were described.

From these lines as bases, strips on either side were mapped to show the limits of the several soil sites. The soil sites having been mapped in the sample strip the catenas were differentiated. With acknowledgments to Mr. Bourne a copy of the completed map is appended (Plate No. 59).

After this stage of the work, stock-mapping and measurement of dominant heights in crops of different ages were undertaken. The crop was thus correlated with the soil.

In Chota Nagpur, in the writer's opinion, much can be done by this method of soil survey both as a basis of working plans and to tell where agriculture encroaches on forest soil or *vice versa*.

Forest Officers in other parts of the world will perhaps find the application of this method helpful, or a modification of it to suit their local conditions.

APPENDIX B

PRELIMINARY CLASSIFICATION OF SOILS

(Descriptions along Knockall's Line.)

PIT No.	GEOLOGY	TYPE	VEGETATION	WOOD	SERIES	REMARKS
1	Lower Old Red Sandstone, Recent alluvium.	Brown Forest Soil	R. H. Me. La	Oak coppice	Lower Old Red Sandstone, Recent alluvium	Deep bores with dark brown loam.
2	Lower Old Red Sandstone, Old alluvium.	do.	do.	do.	Lower Old Red Sandstone, alluvium	do.
3	L. O. R. over Old Red Sandstone.	do. (Good)	do.	do.	do.	do.
4	Do.	do.	H. R. Me. La. Lo. Lu. Eu.	do.	do.	do.
5	L. O. R. with Conglomerate trace.	Degraded B. F. S.	Lu. P. Di.	Open	L. O. R. Conglomerate.	Shallow bores, stony loam, usually light brown.
6	Do.	do.	do.	do.	do.	do.
7	Do.	do.	Lo. P. R. Lu. A.	Oak coppice	do.	do.
8	Do.	do.	do.	do.	do.	do.
9	Conglomerate boulder over L. O. R.	Degraded B. F. S. Truncated Podsol	do.	do.	Conglomerate over L. O. R.	Shallow bores, stony, light brown, gritty loam.
10	Conglomerate	Podsol	do. & V.	do.	Cong.	Shallow bores, stones and orange grit.

11	Upper Old Red Sandstone, Straight.	B. F. S.	R. H. La. Mi. Lu.	Larch	U. O. R.	Deep bores, crimson and stoneless loam.
12	Do.	do.	Nil	Douglas Fir	do.	do.
13	U. O. R. and drift	do.	Nil	do.	U. O. R. and drift	Deep bores, crimson brown loam.
14	U. O. R. on itself	do.	Nil	do.	do.	do.
15	Conglomerate boulder over U. O. R.	Degraded B. F. S.	Lo. P. R. Lu. H.	Young Oak	Cong. over U. O. R.	Shallow bores, stony, light brown, gritty loam.
16	Do.	B. F. S.	R. Lu. Me. A. H. F.	do.	Crush	
17	Conglomerate boulder over itself.	Degraded B. F. S.	Lo. P. R. Lu. H.	Oak coppice	Cong. over U. O. R.	Shallow bores, stony, light brown, gritty loam.
18	Do.	do.	do.	do.	do.	Shallow bores, red clay matrix.
19	Conglomerate	Podsol	Lo. P. R. Lu. H. V.	do.	Cong.	Shallow bores, sandstone blocks in red clay matrix.
20	U. O. R. and drift	B. F. S.	R. P. Me. H. La. Mi.	Oak cut	U. O. R. and drift	Deep bores, crimson brown loam.
21	U. O. R. on itself	do.	do.	do.	do.	Deep bores, crimson brown loam. Map as pits 13 and 14.
22	Do.	do.	do.	Young Oak	do.	do.
23	U. O. R. old alluvium	do.	R. H. Me. La.	do.	U. O. R. and alluvium	Deep bores with dark brown loam.

APPENDIX B—(*concld.*)

Pit No.	Geology	Type	Vegetation	Wood	Series	Remarks
24	U. O. R. old alluvium	B. F. S.	R. H. Me. La.	Young Oak	U. O. R. and drift	Deep bores, crimson brown loam as pits 2, 3, 4.
25	Recent alluvium	do.	Grass	Open	Recent alluvium	Deep bores, dark brown loam.
26	U. O. R. drift on itself.	do.	R. H. La. Mi. Lu. An.	Oak coppice	U. O. R. and drift	Deep bores, crimson brown loam.
27	Do.	do.	Sa. Vi.	do.	Possible line downwash	do.
28	Lower Limestone and shale drift on U. O. R.	B. F. S.—Rendzina	R. H. Me. An. Sa.	do.	LLS drift on U. O. R.	Moderate bore, light brown loam over red clay.
29	L. L. S. drift on itself	Rendzina	A. R. H. An. VI. Ar. Me.	do.	LLS on itself	Shallow bore, yellow brown stiff clay (red stones).
30	L. L. drift on itself	do.	Ar. R. Des. Eu. V. M.	do.	LL drift	Shallow bore, yellow brown stiff clay, no red stones.
31	L. L. clay *in situ*	Glayed—Meadow soil.	R. H. Lo. Des. M.	do.	LL clay beds	Deep bores in yellow and blue clay.
32	Do.	B. F. S.	R. H. Me. La. M.	do.	do.	Granular structure, deep bores.
33	Dolomite over L. L. S.	Degraded Rendzina	M. Hy. R. A. Me. Vi.	do.	Dolomite drift alluvium.	Moderately deep, reddish sticky loam.

34	Dolomite straight	Red Rendzina	H. Ar. Des. An.	do.	Dol. straight	Very shallow red loam over big rocks, granular structure.
35	Dolomite rubble on itself.	B. F. S.	R. La. Me. As.	do.	Dol. rubble	Very shallow red loam over rubble, granular structure.
36	Dolomite drift on itself.	do.	R. M. F.	do.	Dol. on itself	Mod. bore, pinkish, granular, heavy loam.
37	Do.	do.	..	do.	..	Mod. bore, pinkish, granular, heavy loam, sticky.
38	Dol. Old alluvium	Rendzina	..	do.	Dol. rubble	Mod. bore rubble, red loam.
39	Do.	do.	..	do.	do.	Shallow bore, red loam.
40	Do.	do.	..	Young Oak	do.	do.
41	Do.	do.	..	do.	do.	do.

Explanation of Abbreviations (under "Vegetation")

R = *Rubus fruticosus.*
H = *Hedera helix.*
Me = *Mercurallis prellis.*
La = *Lamium galeobdelon.*
Lo = *Lonicera periclymenum*
Lu = *Luzula sylvatica.*
Eu = *Euphorbia amygdeloides.*
P = *Pteridium aquilinum.*
A = *Allium arsinum.*
V = *Vaccinium myrtillus.*

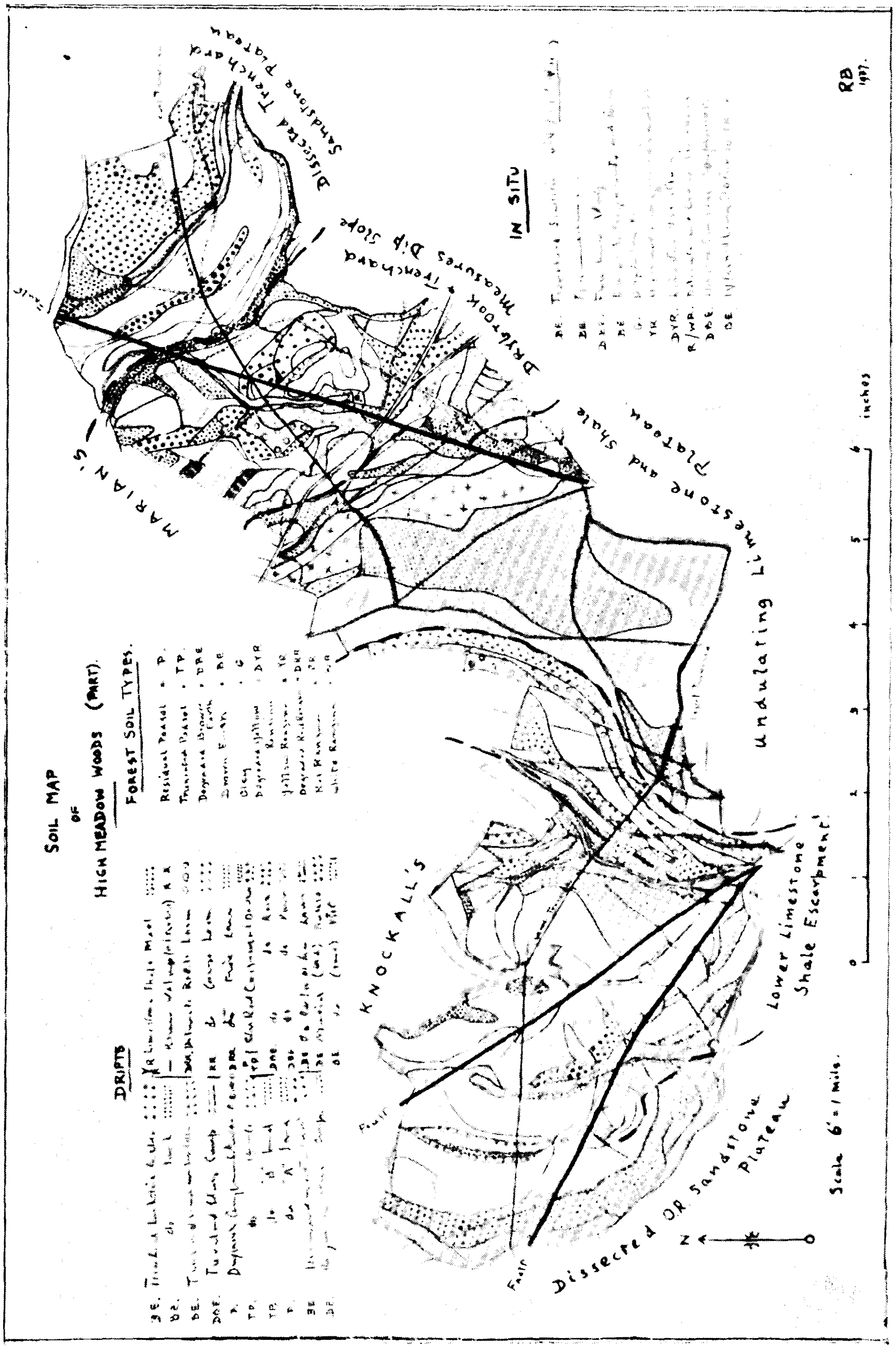
Mi = *Millum effusum.*
F = *Ferns.*
An = *Annemonæ nemorum.*
Sa = *Sanicula europea.*
Vi = *Vida sylvatica.*
Ar = *Arum maculatum.*
Des = *Deschampsia cæspetosa.*
M = *Moss.*
Hy = *Hylocomium tryquetrum.*
As = *Asperula odorata.*

APPENDIX C

SAMPLE DESCRIPTION OF SOIL IN A PIT

1. WORLD TYPE .. Brown Forest Upper Old Red Sandstone.
2. LOCALITY .. Pit No. 22, Knockall's Line.
3. PARENT MATERIAL .. Upper Old Red Sandstone.
4. MODE OF FORMATION .. Local drift.
5. TOPOGRAPHY .. South-east; steep, even slope.
6. DRAINAGE .. Mature.
7. RAINFALL .. 35 inches.
8. VEGETATION .. Rubus, Pteris, Mercuriallis, Hedera, Lamium, Millium —under Young Oak.
9. CATENA .. *Dissected Old Red Sandstone and Lower Carboniferous* Limestone and Shale Plateau.

	Colour		Texture	Structure	Composition	Moisture	pH	Drainage	Root penetration	Fauna—earthworms, etc.
1½″ Mild humus ..	..	..	..	..	..	..	..	..	..	..
1½″–10″ Layer I ..	Light red brown.	Humus	Coarse sandy loam.	..	Fairly compact.	Moist	4·5	Free	Free	*Nil.*
				MERGING.						
10″–30″ Layer II ..	Light red brown.	Humus in wash.	Coarse sandy loam (clay).	Small cloddy.	Compact.	Moisture	4·5 to 5·0	Free	Free	*Nil.*
				MERGING.						
30″+Layer III ..	Dark brown.	..	Clay loam grit.	Cloddy	Compact tenacious.	Wet	4·5	Impact	Little	*Nil.*



The author regrets that it has not been possible to make the print clearer, but as all that is intended is to illustrate the method, this may perhaps serve the purpose.

FOREST FIRES

[*The text of a talk delivered to Forest Villagers by E. K. Krishnan, District Forest Officer, Cuddapah North, on 8th April* 1939.]

We have met here primarily with the object of demonstrating to you the value of an experiment started by the Forest Department for the first time in this district and of which the Deputy Director of Agriculture has spoken to you at some length to-day.

I thought this opportunity should be taken advantage of by us to impress on you some aspects of the administration of the Forest Department which have been causing us some considerable anxiety. I refer to the problem of fires in the district and of the havoc caused by fires of which you have ocular proof before your very eyes.

The total extent of Reserved Forests under the direct control of the Forest Department (excluding areas managed by the *panchayats*) is 938 square miles or about six lakhs of acres. Of this area more than 1½ lakhs of acres have up to this date been set fire to in various parts of the North Cuddapah district. In Sidhout Range alone, out of 83,000 acres of forests managed by us about 14,000 acres, or 1/6th the area, have been burnt. I wonder if you realise what great harm has been done to the State by this thoughtless action of the incendiary.

Let me first of all quote to you the words of our wise and sympathetic Prime Minister on this wanton destruction of plant life. Speaking at the Prize-giving Day of the Forest College at Coimbatore on 2nd July 1938 the Prime Minister said—

> "I have always realised that forests are perhaps our best and most valuable possession, more valuable than what is hidden below even in the shape of gold. The indigenous culture of our country holds the vegetable world in very great esteem and value. It is considered as great a sin to cut down a green tree as to chop a man down. Old-fashioned men even in these days hesitate to cut down a green tree. I wish that that culture had not been interfered with by other ideas and that people retained towards forest the same sacred feeling as they would retain towards a body of living men. But for various causes this idea of the sanctity of vegetable life has been upset and exigencies of life in and round forests have

driven people who live there to go up and steal the permanent asset of our country away in this manner and valuable property has been lost. It is good that people have come to be told 'Better late than never,' and that these things must be conserved. It is a fact that great work has been done by the conservation of the Forest Department and that it should be better recognised. It will be recognised, I assure you, Sir, you are right in saying that I am one with you in appreciating the philosophy of forestry and the actual need for the Forest Department in the country. I do not share the peasants' feeling who, in order to make a couple of annas which he needs very badly—of course he is also a living tree—becomes a temporary parasite of the jungle for the moment, and he goes and steals away the wood to make those two annas."

"Reading the ancient literature of the land where forests have been described who can take an axe and cut down a tree? If you read the Ramayana of Valmiki even Rama is not so grand as the forest itself."

I cannot think of anything more apt to speak in defence of our efforts to preserve the plant life for our own sakes and for the sake of the generation to come than those words of the Premier. If it is a sin to cut off the young life of a promising and sturdy youth by the hand of an assassin it is equally sinful to contrive the death of hundreds of thousands of plant life by the torturing process of fire. For remember, the plants have life the same as you and I have. It may not be so manifest as in the case of human beings; the slow process of growth from flower to seed from a seed to a blade of leaf and thence to a seedling; from a seedling to a full grown tree which yields us the fruits we eat, or the timber and fuel which we use for our hearth and home are all ordained by a Divine Hand which guided the growth and development of a human being exactly in similar stages from a cell to an embryo from an embryo to a child and later on to a full developed human being.

It is no doubt difficult to convince the unthinking herdsman or villager of this aspect of plant life to restrain him from using his chopping knife to kill a tree. It is equally difficult to argue on these lines to an incendiary and stop him from playing with fire in our

easily inflammable forests. But I have far more convincing arguments to advance to persuade you all, and through you to the culprits who perpetrate these heinous crimes, to desist from a practice which is ruining the valuable assets which we have in our forests, however miserable they may appear to be at first sight.

I refer to the indirect influence the forests have on cultivation, on water conservancy, on soil erosion and on climate.

I do not wish to go into great detail on these various uses of forests in the economy of nature. Those of you who can read and understand the various aspects of the question discussed on platforms and essays do not need my exhortation to convince you of the great value forests are in the scheme of every day life. To the uninitiated let me briefly explain one or two significant facts.

First of all to the cultivator and the householder I ask "Is there anything you can do to carry on your normal life in the absence of wood?" From the cradle to the grave you are constantly making demands on wood and using it in various forms. The food you eat is derived from plant life. The cot you sleep on, the house posts you utilize for your buildings, the fuel you kindle your hearth with, the paper you write on, the axe and knife handle you use to fell a tree, the match stick you use to set ablaze the forests—these and very many other articles of daily use are derived from wood or from plant life. Your very life in this world depends on the existence of plants. Is it proper then to destroy plants by fire and illicit hacking in the manner in which you see it has been so wantonly done all around you?

You might ask "Don't you forest subordinates go and fell trees wholesale in a coupe or select the best timber tree for export to Madras and foreign countries for sale?" We do; but there is this difference. If we fell a tree we attempt to replace it with perhaps 10 similar seedlings which will gradually take its place. If we cut the entire growth on a coupe of 50 or 100 acres we give that area rest for say 30 or 40 years to ensure regeneration in that area by coppice shoots. We attempt to keep fire out of that area by removing the inflammable material all round the coupe. Whereas you go and hack a tree, which you think will make a suitable house post, and never dream of planting another tree to take its place. Before

that stump has hardly time to shoot up you go and hack again its tender shoots for fuel, or for leaf manure, or for feeding your goats and your cattle on, or else you set fire to the forests all round and thereby ensure its certain destruction.

Fire and destruction! What terrible enemies of civilization they are! Look around you and see the devastation caused by the thoughtless action of one irresponsible villager. Every tree and shrub, particularly at this season when they are without their mantle of green foliage, has been charred beyond recovery by this conflagration. Every seed shed by the trees to ensure their regeneration has been burnt out. And this at the season when seeds are plentiful on trees and on the ground and are ready to germinate at the approach of the rain. Every vestige of humus on the ground, which should have helped to enrich your soil, has been swallowed up in the fire.

And what, do you imagine, the consequence will be? The hill side will soon be bare of growth. The soil which the roots help to bind and preserve on the steep hill-side will soon slip and be carried down by the rain wash and perhaps silt up your irrigation tanks. There will be nothing left—not even grass in the long run —to obstruct the run-off water. The result will be that directly the rain falls all the water will rush down to the plains, will be carried away by streams and finally rush into the Pennar and cause sudden floods.

On the other hand, had you left the vestige of vegetation on these poorly clad hill-sides to grow to some size, the trees and shrubs and grass would have prevented this rapid run-off of rain water, the rain water would have a chance to percolate into the soil and gradually to feed your wells and your tanks and your streamlets and thereby have ensured for you a perennial source of water for cultivation and for other purposes.

You must not think these are mere hollow statements made to capture your imagination. In countries like France and Germany where scientific forestry has been practised for many centuries it has been proved beyond a shadow of doubt that forests have contributed a very large share to the welfare of mankind. Forests in India have come under proper control and protection only within the last 80 years and therefore we do not realize what value it is and will hereafter be to conserve our water-supply and help to meet

our daily necessities of life. I have already mentioned how they help to feed your wells and your tanks. If proof were needed to show how the slow process of denudation has effected your water-supply you have only to see how water-level has gone down in your tanks and wells scattered about in various parts of your villages and forests. Your ancestors built at enormous expense well lined step-wells and beautiful tanks which at their time must have held perennial supply of water. Now they are dry for about 10 months in the year. Why? Because the catchment area above the tank or well has been ruthlessly cut about, there is no vegetation to absorb the rain water and lead it gently to the underground springs that feed these wells and tanks.

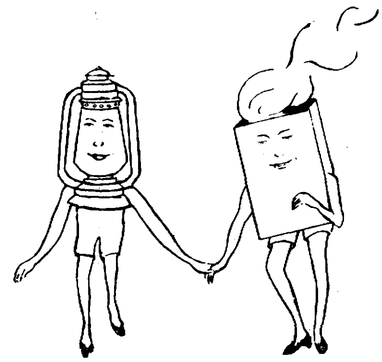
Apart from this effect on water-supply the destruction of forests is causing the nation lakhs of rupees in direct loss. Our forests are of so poor quality now that the surplus revenue we get from the type of forests in Cuddapah is hardly three pies per acre per annum. The forests now carry mere scrub jungle where once valuable Red sanders, *Yelama, Yepi, Thumma, Maddi, Chinduga, etc.*, trees were plentiful. The forest soil has so deteriorated by constant fires that these valuable trees have no chance of survival except in remote and moist localities where fires have not traversed and the illicit tree-cutters have not reached.

Think of the enormous loss caused to the State every year by fires. We have in this division alone over six lakhs of acres of reserved forests in our charge. This is excluding about one lakh of acres of forests under *panchayat* management. Of this six lakhs of forests more than $1\frac{1}{2}$ lakhs of acres were burnt last year. There were 182 fires altogether in the division. 182 fires which burnt 26 per cent. of the forests of this division! Assessing the value of the type of forests we have at the low figure of one rupee per acre and assuming that 1/16th of the total number of trees is either killed outright or so damaged and mutilated as to become useless for exploitation later, we calculated the loss to be one anna per acre of forests burnt. At this conservative estimate the State has lost Rs. 9,619 owing to fires last year. We have no up-to-date figures available yet of the total extent burnt this year. But fires, if anything, have been more frequent and larger areas have burnt this year than during last year owing to the failure of the North-East Monsoon. So we can take it

that every year the forest fires are responsible for the loss to the State to the tune of about Rs. 10,000. Rs. 10,000 wasted year after year which if well spent on irrigation works or on improvement of industries would have rendered hundreds of homes happier. We, of the Forest Department, are usually looked upon as being hostile to the welfare and interests of the ryots, and unnecessarily harsh in the management of the forests entrusted to our charge. This is a very uncharitable view to take of our activities. Let me give you some little idea of the many ways in which we try to be helpful to people in general and to the ryots of forest villages in particular.

We have many forest activities for which we employ a large number of labour. To cite a few we have fuel, bamboo and timber exploitation we give contracts for the extraction and transport of these produce in various parts of the district in all seasons of the year; we allow grazing of cattle throughout the forests of the district. Do you realize what a large army of labour we employ directly and indirectly on these operations? On departmental works alone, we employ over 26,000 coolies who earn more than Rs. 11,000; through the agency of contractors more than $1\frac{1}{2}$ lakhs of men and women are employed who earn more than one lakh of rupees; on grazing alone we give employment to seven lakhs of coolies who, if they were paid daily wages in cash, would earn about $1\frac{1}{4}$ lakhs of rupees. In fact, on all these items of work, we employ on the whole about 9 lakhs of men who earn about 3 lakhs of rupees. Can you say then, that the administration is not helpful to the ryot population.

We strive to improve or at least to check the deterioration of a valuable national asset which we have been called upon to manage. In managing this we have to think not merely of the present generation but of the posterity who have an equal claim on all the benefits —direct and indirect which accrue from a well managed forest. When you people who live near the forests come to realize that these interests will be better served by us with your co-operation rather than with hostility and distrust in us, the task before us will be easier and you can look forward to a day when these barren hill sides will gradually regain their beauty of verdure which the relentless fires have so ruthlessly destroyed.



THE INDISPENSABLE PAIR

By E. C. Bor.

From the Suez Canal to Singapore
From Dehra Dun to Bangalore
Your water supply (and your light) depends
On a pair of indispensable friends.
To the Mystic East they usher you in—
Hurricane *Butti* and Kerosene Tin.

Whatever your job, wherever you go,
On the tops of the hills or the plains below,
At the back of your car you'll always find
A Kerosene tin tied on behind,
While—into your bedding—the servants fling
A Hurricane *Butti* tied up with string.

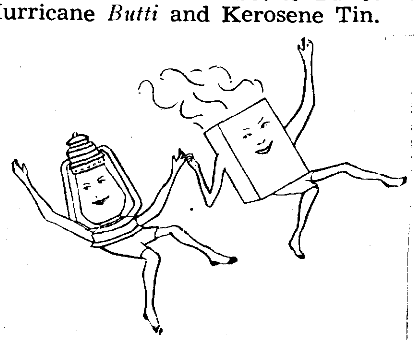
Climbing Everest, crossing Sind,
Wherever you go in the land of Ind—
Forests or Police, P. W. D.,
I. C. S.—whatever you be—
In Government House, you'll find us there—
Indispensable everywhere.

You may tour your forests the whole day long:
You may fish or shoot—but you can't go wrong,
Unless you've dared to go into camp
Without the support of a hurricane lamp.
A hurricane lamp to light you in
To your bath, prepared in a kerosene tin.

Your elephant follows the tiger's trail
With a Hurricane *Butti* tied on to his tail.
No matter your mission—you'll always find
A kerosene tin's not far behind.
For the camper's day can never begin,
Till the tea's been boiled in a kerosene tin.

English baths and electric light—
As far as they go they're quite all right.
But they *don't* go far in the mystic East:
Beyond the cities, you'll find they've ceased.
In the jungle depths once more you'll cry
For your faithful friends who are standing by.

They're standing by, and they're always there
Whenever you want them—everywhere.
From the Ran of Cutch to Negapatam,
From Mandalay to Baluchistan—
From the snows of Tibet to Tuticorin—
Hurricane *Butti* and Kerosene Tin.



STATEMENT OF WILD ANIMALS SHOT IN SOME OF THE

All-India serial number.	Species.	Ajmer-Merwara.	Assam.	Bengal.	Bihar.	Bombay.	Burma.
1a	Tiger ..	..	17	40	7	23	67
1b	Tigress ..	..	1	11	3	11	..
2	Leopard or panther ..	..	2	55	4	59	38
3	Wild cats (species to be given if known).	..	1	21	2	1	..
4	Lynx ..	..	..	..	..	..	..
5	Hunting leopard or cheetah.	..	..	..	..	..	..
6	Hyena ..	..	..	..	3	3	..
7	Wolf ..	..	..	..	..	..	..
8	Wild dog ..	..	..	2	5	..	66
9	Martens ..	..	..	..	..	..	..
10	Ratel ..	..	..	..	..	..	..
11	Brown bear ..	..	..	..	..	..	..
12	Himalayan black bear ..	..	..	4	..	..	..
13	Malayan bear ..	..	..	..	..	..	..
14	Sloth bear ..	..	1	1	..	5	209
15	Wild elephant ..	..	32	11	..	11	543
16	Rhinoceros (species to be given).	..	1*	..	..	..	..
17	Gaur or bison ..	1	..	1	3	19	35
18	Goyal or mithan ..	..	1	..	..	..	35 (saing)
19	Banting or tsine ..	..	..	..	..	..	..
20	Wild buffalo ..	..	2	..	2	..	..
21	Urial or sharpu ..	..	..	..	..	..	..
22	Bharal or blue sheep ..	..	..	..	..	..	..
23	Ibex ..	..	..	..	..	..	..
24	Markhor ..	..	..	..	..	..	..
25	Tahr ..	..	..	3	..	..	..

*Unicorn, died after being caught in a pit.

INDIAN PROVINCES, INDIAN STATES AND BURMA DURING 1937-38

C. P.	Coorg.	Madras.	Orissa.	Punjab.	U. P.	Jammu and Kashmir State.	Bastar State.
112	12	11	16	..	73	..	12
..	..	8	3	..	43	..	..
72	4	31	14	16	84	96	65
..	..	86	49	7	19	..	..
..	..	..	..	..	..	3	..
..	88	2	..	..	..	..	..
7	..	3	1	..	21	..	..
..	..	..	..	..	..	109	..
16	10	26	3	..	9	..	16
..	..	1	..	..	26	..	..
..	..	..	..	..	1	..	..
..	..	..	..	1 (red)	..	20	..
..	..	..	..	4	15	28	..
..	..	..	..	..	..	..	..
37	..	4	10	..	10	..	..
..	..	3	1	..	..	..	..
..	..	..	..	..	..	..	..
15	1	22	2	..	..	..	1
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	4
..	..	..	..	14	..	12	..
..	..	..	..	2	..	10	..
..	..	..	..	2	..	25	..
..	..	..	..	..	..	8	..
..	..	..	..	2	2	4	..

Statement of Wild Animals Shot in some of the Indian

All-India serial number.	Species.	Ajmer-Merwara.	Assam.	Bengal.	Bihar.	Bombay.	Burma.
26	Nilgiri wild goat or Nilgiri ibex.	..	..	..	..	..	..
27	Serow or Himalayan goat-antelope.	..	..	4	..	..	8
28	Goral ..	..	..	..	..	..	..
29	Nilgai or blue bull ..	2	..	..	2	44	..
30	Four-horned antelope ..	..	..	..	..	3	..
31	Black buck ..	..	..	..	..	..	..
32	Indian gazelle or chinkara.	1	..	..	..	3	..
33	Barking deer or kakar ..	..	10	84	5	2	343
34	Kashmir stag or hangul	..	..	..	..	..	..
35	Swamp deer or gond or barasingha	..	..	..	..	..	..
36	Brow-antlered deer or thamin.	..	..	..	..	..	5
37	Sambar ..	..	8	37	17	15	209
38	Cheetal or spotted deer or axis deer.	..	1	313	9	25	..
39	Hog deer or para ..	..	4	11	..	..	28
40	Musk-deer ..	..	..	..	..	..	..
41	Mouse-deer ..	..	..	..	..	..	..
42	Pangolin ..	..	..	..	..	..	..
43	Crocodile (muggar) ..	..	..	7	..	..	..
44	Gharial ..	..	..	6	..	..	..
45	Python ..	..	..	36	..	..	..
46	Others (species to be given). ..	2 (pig)	3 (malabar squirrel 1) (bear 2)	305 (pig 300) (hare 3) (porcupine 2)	20 (pig 5) (hare 15)	742 (pig)	251 (pig)

Provinces, Indian States and Burma during 1937-38—Concluded

C. P.	Coorg.	Madras.	Orissa.	Punjab.	U. P.	Jammu and Kashmir State.	Bastar State.
..	..	9	..	..	..	..	..
..	..	..	..	..	..	..	..
..	..	..	..	25	22	6	..
70	..	1	..	32	57	..	5
..	..	..	..	..	4	..	..
..	..	1	..	..	31	..	..
..	..	..	..	2	4	1 (Tibetan gazelle)	..
100*	..	23	13	13	57	..	..
..	..	..	..	..	..	9	..
..	..	..	..	..	19	..	..
..	..	..	..	..	..	..	..
103	1	26	19	2	119	..	5
119	7	22	6	1	230	..	27
..	..	..	..	2	23	..	..
..	..	..	..	..	1	..	..
..	..	2	..	..	..	..	..
..	..	..	..	..	..	..	..
6	..	2	..	..	7	..	..
..	..	..	..	..	..	..	..
..	..	1	..	..	2	..	..
768 (pig)	..	10	8 (pig)	104	975 (porcupine, pig, etc.)	17 (Ovis ammon 7) (others 10)	50 (bear 26) (pig 9) (hunder 2) (kotri 13)

*Includes species of Serial Nos. 31 and 32.

TIMBER PRICE LIST, FOR JULY-AUGUST 1939

(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 36-0-0 to 42-0-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 50-C-0 to 61-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-13-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-12-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-14-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-2-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 56-4-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 42-3-0 to 51-9-0 per ton.
" ..	" ..	Bihar ..	Logs ..	
" ..	" ..	Orissa ..	Logs ..	Re. 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 80-0-0 to 100-0-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 31-4-0 to 48-7-0 per ton.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 60-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	
" ..	" ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 37-8-0 to 45-5-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 55-0-0 per ton.
" ..	" ..	" ..	B. G. sleepers	Rs. 5-8-0 to 5-12-0 each.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-9-3 each.
" ..	" ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	
" ..	" ..	" ..	B. G. sleepers	
" ..	" ..	" ..	M. G. sleepers	
" ..	" ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-4-0 per c.ft.
" ..	" ..	U. P. ..	Logs	Re. 1-0-0 to 1-6-0 per c.ft.
" ..	" ..	" ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
" ..	" ..	" ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Re. 0-14-0 to 1-2-0 per c.ft.
" ..	" ..	Bihar ..	Logs ..	
" ..	" ..	Orissa ..	Logs ..	
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
" ..	" ..	Bihar ..	Scantlings ..	
" ..	" ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	
" ..	" ..	U. P. ..	Logs ..	Re. 0-12-0 to 1-6-6 per c.ft.
" ..	" ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
" ..	" ..	" ..	Logs 2nd class	
" ..	" ..	C. P. ..	Logs ..	Re. 0-13-3 to 2-4-2 per c.ft.
" ..	" ..	" ..	Squares ..	Rs. 1-8-4 to 3-1-4 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 85-0-0 to 137-8-0 per ton.
" ..	" ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
" ..	" ..	" ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

EXTRACTS

A BOARD OF AFFORESTATION NEEDED

An announcement was made recently that a Board of Forestry has been constituted by the Government of India to form, as it were, a kind of link between research connected with forest materials and their utilisation and industry based on those materials and to help the provincial governments in the matter of getting research work done regarding particular problems connected with forest produce and their use. This is a good move. India can derive much greater benefit from her forest produce than she has been doing and various new industries, giving employment to thousands, can be established on the basis of the varied forest produce. If the Board of Forestry does its work well and with energy and enthusiasm, there is no doubt that progressively greater and greater efforts will result for utilising the forest wealth of the country to the full. There is, however, one important matter connected with the forest wealth of the country to which little attention is being paid even now. It is an undoubted fact that the area under forest has been gradually declining and that the valuable forest trees, which are being cut annually, are not being replaced by new plantations, at least to the extent required. An idea of the extent of depletion that must be taking place annually can be had from the amount of timber used by only one consumer—the biggest no doubt—only, namely, the railways. A statement issued the other day shows that some 27,000 miles or a little more than half the track of the chief railways of India, is laid on wooden sleepers, and to maintain this track in good order some 13 lakhs of broad-gauge and 14 lakhs of metre-gauge sleepers are purchased annually, or about 123,000 tons of timber in all. Over and above this, special sized sleepers are purchased for points and bridges and the total money passed by the railways to the timber trade for wooden sleepers last year was over a crore of rupees. The above figure does not include the smaller railways, which total some 5,610 miles of track in all and most of which is also on wooden sleepers. Besides the timber required for sleepers, the railways also use some 20 thousand tons of sawn timber annually in the carriage and wagon shops. The price of this timber

came to something like 35 lakhs of rupees last year. Thus, nearly a crore and-a-half rupees worth of timber in money value is consumed by the railways only. Consumption by others for other purposes must be even larger because timber and wood are used for so many purposes and by almost the entire population for one purpose or another. From these one can estimate what enormous depletion of forest trees is going on. There is nothing inexhaustible in this world—certainly not the forest wealth of this country. If depletion goes on at this rate, a time will come when it will be difficult to get the necessary supplies of timber, particularly of good qualities. We believe difficulty is already being felt. The supply of wood for fuel purposes has certainly run short markedly. Coal is being used nowadays extensively as a substitute for fuel wood, but the coal-mines of India are also not inexhaustible. Perhaps they may be exhausted much earlier than the forests. With both forests and coal-mines exhausted, what will become the condition of the people? Should not then an attempt be made to preserve them as long as possible?

Coal is wholly a natural product. No human agency can help to increase its quantity. All that human beings can do is to use it as sparingly as possible. That is the only way in which the life of coal-mines can be prolonged. Trees can, however, be grown and as extensively as people desire. And if trees are grown extensively, the requirements of coal may be put down to very low figures. There is urgent need, therefore, to grow more trees. In other words, there is need for afforestation. In the first place, trees must be planted to replace those which are cut so as to maintain the supply of sal and teak woods required for railway and other purposes at least at the present level. In the second place, trees must be planted also for the supply of fuel wood, if possible, to all people so that the necessity of using coal for this purpose may be reduced to a minimum and, what is even more important, the use of cowdung for fuel purposes may be entirely eliminated and the article is utilised instead for manuring purposes. Afforestation is thus necessary on an extensive scale and it must be done on a planned and systematic basis. The provinces and the states may individually do their part of the work and within their own jurisdiction but there must be co-ordination of the work of all also and for that, we think, an all-India Board is a necessity. The Government of India has established a Board for

stimulating research work and industries. It should also appoint a Board for stimulating afforestation work. We have repeatedly drawn attention to the need of systematic afforestation—without success so far—but the importance of the subject compels us to write again. May we hope to get better response this time?—*The Searchlight,* Tuesday, 23rd May 1939.

VALUABLE PRODUCTS FROM LIGNIN

By adding hydrogen to lignin—chemistry's problem child—scientists of the U.S. Forest Service's Forest Products Laboratory at Madison, Wisconsin, have learned how to convert this waste product of wood into products that bear promise of being valuable raw materials with many uses.

One is a well-known product—methanol, or wood alcohol. Four others had not been previously discovered, although one of the group was described as theoretically possible by a German scientist. The properties of these new substances are such as to suggest their use as wood preservatives, fungicides, insecticides, adhesives, solvents and plastic materials.

The co-discoverers, Dr. E. C. Sherrard and Dr. E. E. Harris, describe the first new substance as paraprophylcyclohexanol, valuable as a solvent for organic gums and resins, and oils used in lacquers. It has value as a preservative, and is about as repellent to insects as creosote.

The second and third substances, described as 4-propyl, 1, 2-dihydroxycyclohexane and 3-p-hydroxycyclohexylpropanol, are thick liquids which become solid after standing a long while. Both may be made into plastic materials.

The fourth substance is crystalline and unnamed, as the discoverers have not yet determined the positions of the carbon, hydrogen, and oxygen atoms of which it is composed.

Because of its complex chemical nature, lignin in its natural form has baffled scientists. By submitting it to the hydrogenation process, the Forest Service scientists changed its chemical nature so that it could be broken down into component parts. The Hydrogenation process already is in use commercially in making hard fats

from vegetable oils, in making petroleum oils from coal, and in getting phenomenal yields of gasoline and gas oils from natural petroleum.

In the laboratory tests the hydrogen atoms were added to a solution of purified lignin by means of heat and pressure and the use of a catalyst—copper chromium oxide—another chemical inducing rapid reaction, yet taking no part in it. Under this treatment the dirty, brown lignin solution changed to a thick, sticky and colourless fluid. The catalyst was removed by the use of a centrifuge, which works on the principle of a cream separator. The residue was then distilled, or fractioned, to create the wood alcohol and the four new substances.—*Scientific American*, June 1939.

WOODEN VERSUS METAL SLEEPERS

The figures of annual purchases show the railways to be the biggest supporters of the timber trade in India. The timber is used for two main purposes, namely, sleepers and the construction of carriages and wagons.

Some 27,000 miles, or a little more than half the track of the chief railways of India, is laid on wooden sleepers, and to maintain this track in good order, some 13 lakhs of broad-gauge and 14 lakhs of metre-gauge sleepers are purchased annually, or about 1,23,000 tons of timber in all. Over and above this, special sized sleepers are purchased for points and bridges, and the total money passed by the railways to the timber trade for wooden sleepers last year was over a crore of rupees. This figure does not include the smaller railways which total some 5,610 miles of track in all and most of which is also on wooden sleepers.

More than half the wood used for sleepers is *sal,* and *sal* is an ideal wood for sleepers inasmuch as it is naturally durable, lasting some 15 years without treatment in the track. There are large areas of *sal* forest in Assam, Bengal, Bihar, Orissa, the Central Provinces and the United Provinces. Much of the timber can still be obtained from jungles quite close to the main lines, but fellings over a long period of time have resulted in recent years in sources of supply moving farther from the consuming railways. The other sleeper

timbers used are mainly coniferous timbers, some five lakhs of sleepers of which are obtained annually from the hill forests of Kashmir, the Punjab and the United Provinces: Indian grown teak sleepers also come from the Bombay Presidency and Madras, and the less naturally durable jungle woods of South India also provide the railways with considerable quantities of sleepers annually.

The wooden sleeper, however, is not without its competitor, as the other half of the track, or about 23,000 miles, is laid with metal sleepers, either steel or cast iron. The designs of these metal rivals have been greatly improved in recent years, and a life of about 45 years is claimed for the cast iron sleeper. Every cast iron sleeper that is laid, therefore, eventually displaces three wooden ones. But the first cost of the wooden sleeper is about half that of the metal: it is easy to handle and lay, and the popularity of wood is indicated by the fact that the value of wooden sleepers purchased last year was nearly five times that of the metal rivals.

The railways use some 20,000 tons of sawn timber annually in the carriage and wagon shops. Rather more than half of this is Burma and Malabar teak, and the other half includes timber of other indigenous species, and timber from the Andamans. About 35 lakhs of rupees were spent in all by the chief railways in India in 1937-38 on such timber.

The extensive use of teak is mainly due to the fact that apart from its durability, it possesses unique qualities as a furniture wood, especially in the matter of steadiness. It is one of the very few timbers which can be used with little seasoning soon after conversion and without risk of shrinkage and warping. (Andamans Padauk possesses this property also, but the supplies of this timber are very limited.) This quality gives teak a special place in carriage construction. Attempts have been made to kiln-season other indigenous timbers, but the treatment was found to be costly, and as no treatment can confer upon other timbers the qualities which teak possesses, it is unlikely that the latter will lose its place as the most extensively used timber in carriage construction. Indigenous timbers are, however, used for floors of wagons and other purposes which do not call for the qualities possessed by the more expensive teak.

Here, again, the teak supplier has his competitor in the matter of plywood and other substitutes for panels, and with the improve-

ments which have been made in the manufacture of glue in recent years, it is probable that plywood panels will find a growing use in future carriage construction.—The Engineering Correspondent, *Capital*, 18th May 1939.

ST. ANDREWS GOLF LINKS

STARVATION TO DEVELOP BRISTLE-LEAVED GRASS

Sand in Nature's Wheels.—Professor R. J. D. Graham of the Chair of Botany at St. Andrews University, who is of opinion that what the St. Andrews golf links need is starvation, rather than artificial feeding, to prevent deterioration, told St. Andrews Rotary Club, at the weekly meeting, that his views are now being considered by the Green Committee of the Royal and Ancient Golf Club of St. Andrews.

Speaking as a naturalist, he gave it as his opinion that all the courses needed was coatings of sand, instead of artificial manures. As a hard diet made the hardy Scot, so would natural treatment of the golf links restore them to their former glory.

Professor Graham said that to the naturalist and to the golfer alike, the changes seen in our Scottish seaside links brought nothing but regret. In the upgrade from the loose sand of the shore to the stable dune with its close turf, which formed the links, the naturalist saw nature at her work. He realised that in time that turf, by its very decay, must change the surface, preparing the way for other plants. But he knew full well that many generations would pass ere nature in her leisurely way, would accomplish this. Yet in thirty years the process was complete on the courses at St. Andrews. The fields were white with daisies, there were worm-casts on the greens, the bristle-leaved seaside grasses had vanished and all summer one viewed the water-sprinklers at work fostering the soft, new turf. Save for the moan of the North Sea and the grey city to the east, there was nothing to distinguish this from any other course in the world.

Plant Succession.—The seaside links owed their existence to, and were the natural outcome of, the influence of the perennial sand-binding grasses of our coasts. Lyme-grass, introduced to St. Andrews

from Holland by Charles Howie, on the low-lying stretches of the coast, started its work at high-water mark, fixing the loose sand into low dunes. Behind those, Marram grass built the more prominent dunes that fringed the West Sands. The sand held in place by these grasses required the growth of smaller plants before the white dune was converted into the grey dune. The skin of turf-forming plants gave permanence to the work of the sand-binding grasses.

No plant was more typical of the short seaside turf than the hardy, springy, bristle-leaved grass. The lightsomeness of the tread on this living carpet was known to every lover of the seaside. The further agents which transformed the grey dune into the golf links were animals and man. Rabbits trimmed the grasses, producing the close-cropped turf dear to the golfer's heart, though their scrapings might raise his ire. Yet these very scrapings, by scattering sand on the turf, maintained by natural means the growth of the real bristle-leaved hardy seaside grasses. The rabbits also kept in check the invasion of the turf by woody plants—whin and heather—which was the sequel of the consolidation of the grey dune.

Man Takes a Hand.—Thus far, the course of events had been an ordered advance due to Nature. Now man took a hand. Changes which Nature would bring about in many generations of man's life occurred in as many years. Mowers were brought in to crop the turf. They left in their wake a trail of raw grass remains which settled on the soil and clogged the porous surface. The modern motor mowers, by their very weight, compacted and bound the matted surface. Worms, which were absent from the dunes, as there was poor feeding for them in the open sand, made their appearance with the increasing organic matter in the soil. They would tend to keep the surface open, but the green-keeper dosed them with iron salts. The iron salts permanently cemented the surface particles, giving a concrete basin which held every drop of rain as casual water on the greens. The heavier soil was now a choice site for daisies. To rid the links of their summer mantle of white, artificial manures were applied to assist the vanishing grass plants in their losing fight. These artificial manures assisted the growth of the more responsive broad-leaved grasses, which finally ousted the typical seaside grasses with their hard bristle leaves. These soft broad-leaved grasses would not stand up to the wear of modern conditions. The courses must be closed

to allow these grasses to recover; they were artificially fostered grasses that required watering to keep them green in summer.

"Thus the seaside links, with their soft grass intermingled with daisies, with their greens covered with worm-casts, have changed rapidly, through man's interference, into an inland course. Were it not for the murmur of the waves, and the tang of the salt air, one might as well play in the heart of the country. Could anything have been done to prevent this? Undoubtedly much could have been done to slow down the change.

Tom Morris's Solution.—Tom Morris had the solution of the problem from the rabbits. He watched them at their work of scattering sand, but he uttered the solution to unhearing ears. Sand and more sand, and when you have done that, more sand, was what he pleaded for. It was good advice, but not spectacular; the remedy did not call for vast expenditure, and, because it was not offered in a foreign accent, it was not heeded."

The upgrade from loose sand to fixed dune, from dune to seaside turf, from seaside turf to land fit for crops, was undoubtedly a natural one, and no one could turn back the wheels of Nature. Yet by keeping the land poor, by spreading sand and keeping the surface open, only the hardy grasses would survive, and the seaside turf would for long dominate the scene. Nature's wheels might not move back, but their progress might be slowed down by putting sand in them.—*The Scotsman,* April 3rd, 1939.

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons) Month of June 1937	1938	1939	3 Months, 1st April to 30th June 1937	1938	1939
Wood and Timber						
Teakwood—						
Siam ..	..	115	10	360	397	20
French Indo-China	92	6	135	690	654	786
Burma ..	15,143	11,471	9,836	42,233	36,191	35,193
Java ..	85	203	187	589	924	1,132
Other countries ..	..	22	..	387	22	..
Total ..	15,320	11,817	10,168	44,259	38,188	37,131
Other than Teak—						
Softwoods ..	1,969	952	629	4,714	4,549	3,948
Matchwoods ..	1,380	1,281	1,033	3,195	3,153	3,003
Unspecified (value)						
Firewood ..	36	62	90	199	157	150
Sandalwood ..	10	..	..	25	26	30
Total ..	3,395	2,295	1,752	8,133	7,885	7,131
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		No data			No data	
Sleepers of wood ..	..	32	157	77	129	279
Plywood (tons) ..	502	766	1,025	1,686	1,708	2,059
Other manufactures of wood (value) ..	..	No data			No data	
Total ..	502	798	1,182	1,763	1,837	2,338
Total Volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	24,756	17,044	19,839	52,833	83,679	42,398

Seaborne Trade and Navigation of British India for June 1939 :

IMPORTS

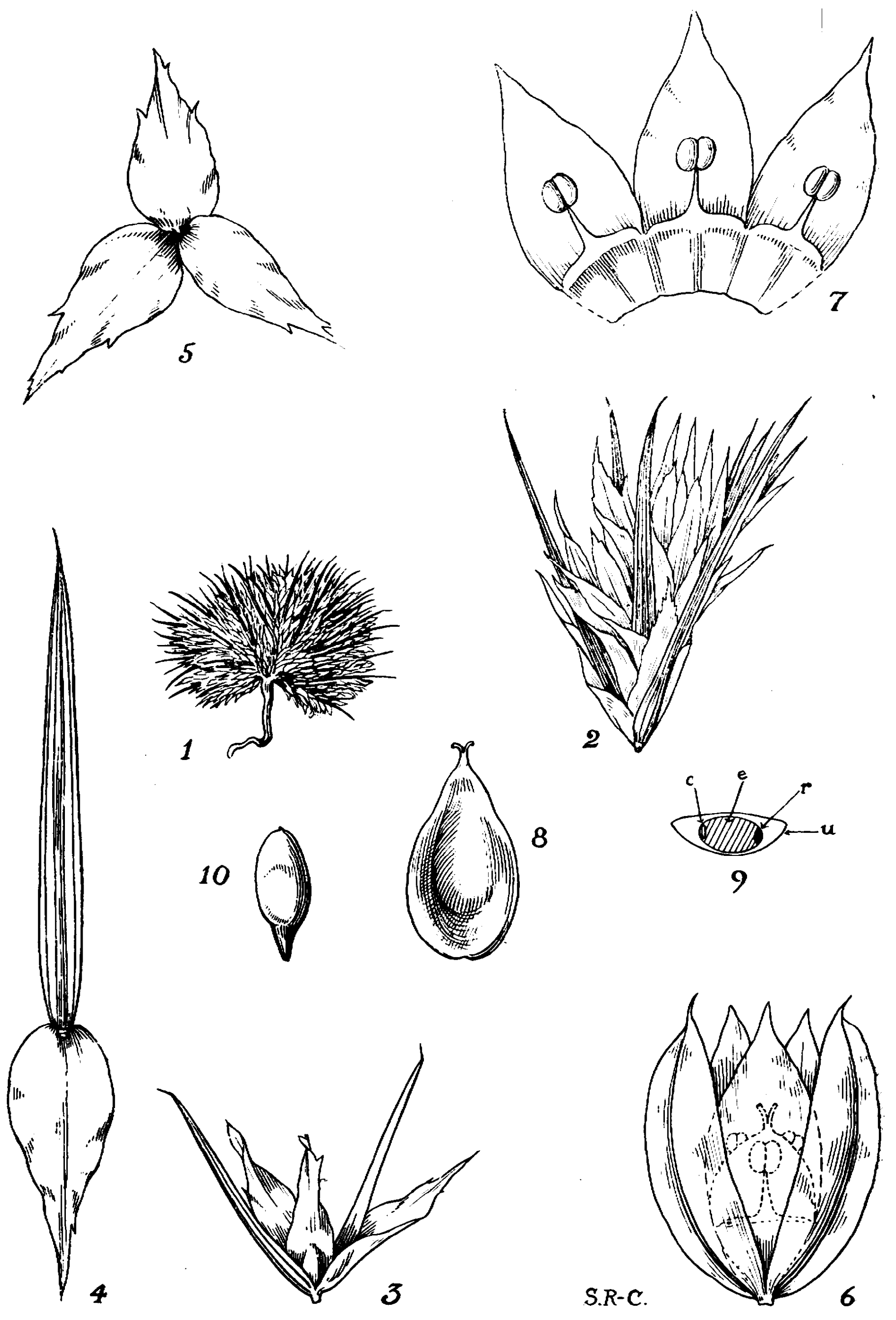
ARTICLES	VALUE (Rupees)					
	MONTH OF JUNE			3 MONTHS, 1ST APRIL TO 30th JUNE		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	..	22,469	1,112	41,120	56,782	2,224
French Indo-China	10,333	1,059	15,204	74,583	76,147	87,717
Burma ..	18,65,282	15,75,712	12,52,605	52,09,024	49,92,268	45,10,492
Java ..	7,292	24,517	19,384	70,643	98,252	1,17,485
Other countries ..	..	806	..	42,409	806	..
Total ..	18,82,907	16,24,563	12,88,305	54,37,779	52,24,255	47,17,918
Other than Teak—						
Softwoods ..	1,48,580	74,876	41,711	3,34,369	3,49,315	2,61,764
Matchwoods ..	82,810	89,871	72,140	1,95,047	2,08,534	2,14,244
Unspecified (value)						
Firewood ..	540	930	1,360	2,982	2,333	2,260
Sandalwood ..	5,283	149	74	6,934	3,752	5,958
Total ..	2,37,213	1,65,826	1,15,285	5,39,332	5,63,934	4,84,226
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	..	..	..	..	..	..
Sleepers of wood ..	..	4,366	21,426	12,016	18,386	37,311
Plywood (tons) ..	1,11,525	1,50,498	1,74,396	3,81,590	3,62,873	3,87,914
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	1,11,525	1,54,864	1,95,822	3,93,606	3,81,259	4,25,225
Total value of Wood and Timber ..	25,84,515	22,98,674	20,86,406	74,86,112	73,96,277	68,38,446
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	2,05,206	1,87,686	1,50,857	3,93,244	8,27,983	3,50,284

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF JUNE			3 MONTHS, 1ST APRIL TO 30th JUNE		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	2	..	..	25	..	20
,, Germany ..	..	..	..	..	1	..
,, Iraq ..	7	3	7	71	58	19
,, Ceylon ..	..	..	25	..	1	30
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	72	115	126	163	37	510
Total ..	81	118	158	259	431	579
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	3	..	..
Unspecified (value)	..	..	..	..	..	..
Firewood ..	..	..	..	115	..	..
Total ..	..	..	..	118	..	..
Sandalwood—						
To United Kingdom	..	1	..	2	1	..
,, Japan ..	..	..	..	1	4	51
,, United States of America ..	107	50	15	167	135	20
,, Other countries	35	5	26	125	33	83
Total ..	142	56	41	295	173	154
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	No data			No data		
Total value of Wood and Timber ..	No data			No data		
Other Products of Wood and Timber	No data			No data		

EXPORTS

ARTICLES	VALUE (RUPEES)					
	Month of June			3 Months, 1st April to 30th June		
	1937	1938	1939	1937	1938	1939
Wood and Timber						
Teakwood—						
To United Kingdom	520	..	100	3,682	..	2,600
,, Germany ..	..	..	..	..	150	..
,, Iraq ..	1,442	835	1,779	14,586	19,062	4,852
,, Ceylon ..	..	..	1,725	..	109	2,145
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	19,540	50,162	31,977	41,772	1,22,155	86,194
Total ..	21,482	50,997	35,581	60,040	1,41,476	95,791
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	840	..	..
Unspecified (value)						
Firewood ..	..	..	..	1,027	..	..
Total ..	..	..	..	1,867	..	..
Sandalwood—						
To United Kingdom	..	375	..	2,600	375	..
,, Japan ..	..	..	..	600	3,973	54,025
,, United States of America ..	1,08,000	50,000	15,500	1,66,040	1,42,000	20,500
,, Other countries	35,919	4,900	25,500	1,30,956	36,672	82,297
Total ..	1,43,919	55,275	41,000	3,00,196	1,83,020	1,56,822
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	22,957	46,607	27,918	53,645	87,987	87,864
Total value of Wood and Timber ..	2,92,251	1,62,501	1,45,165	10,89,274	4,78,035	4,40,089
Other Products of Wood and Timber	No data			No data		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INDIAN FORESTER

OCTOBER 1939

A NEW GENUS AND SPECIES OF CARYOPHYLLACEAE (ILLECEBRACEAE)

BY N. L. BOR, M.A., D.Sc., F.L.S., I.F.S.,

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and

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KABULIA Bor et Fisch., genus novum CARYOPHYLLACEARUM (ILLECEBRACEARUM, tribus POLLICHIEARUM): CARDIONEMATI DC. (PENTACAENAE BARTL.) affinis, a quo foliis alternis, perianthio trilobato, staminibus 3, *staminodiis* 0, *ovario ad basin haud contracto, embryone valde curvato, facillime distinguitur.*

Species unica.

KABULIA AKHTARII Bor et Fisch., spec. nov.

Herba annua, humilis, pulvinatim caespitosa, usque 2 *cm. alta. Radix gracilis, usque* 1 *cm. longa. Folia alterna,* 3-*nervia, distiche congesta, subulata, rigida, pungentia,* 4.5—16.5 *mm. longa, viridia, demum rubescentia et cum stipulis, bracteis, bracteolis, perianthio et semine decidua. Stipulae scariosae, albae, in laminam ovatam vel ovato-lanceolatam conjunctae,* 4.5—5.5 *mm. longae, acuminatae, dente unico supra partem mediam utrinque auctae.*

Flores hermaphroditi, axillares, inconspicui, solitarii, bracteis 3 *scariosis inaequalibus lanceolatis vel ovatolanceolatis* 4.5—5.5 *cm. longis acuminatis diverse denticulatis involucrati. Bracteolae* 2, *scariosae, albae, naviculares, acuminatae, dorso alatae,* 2 *mm. longae. Perianthii segmenta* 3, *scariosa, alba, lanceolata, acuta,* 1.5 *mm. longa. Stamina* 3, *basi segmentorum inserta et iis opposita; filamenta ensiformia,* 0.5 *mm. longa; antherae subglobosae, biloculares, purpureae. Ovarium superius, complanato-ovoideum, sectione*

lenticulare, 0.7 mm. longum, 1-loculare; ovulum solitarium, stipitatum, e funiculo erectum; stylus 0.2 mm. longus, ad partem mediam bifidus; stigmata minutissima, capitata.

Utriculus 1.5 mm. longus, 1.25 mm. latus, ovatus, obtusus, pallidus, apice stylo et stigmatibus coronatus, perianthii reliquiis inclusus. Semen orbiculare vel late ellipsoideum, sectione lenticulare, apice in papillam brevem crassam extensum, ex rubro subnigrum, longitudinaliter minutissime punctato-striatum; hilum basilare; embryo ad perpendiculum curvatus; cotyledones et radicula adscendentes; albumen sat copiosum.

A small annual herb forming mats on the rocky slopes of the mountains surrounding Kabul, Afghanistan. This plant flowers in spring when the snows disappear and is in ripe fruit in December. Collected by Professor S. A. Akhtar of the Kabul University in the summer of 1938. Typus in Herb., Dehra Dun, No. 78512. Duplicate at Kew.

We append a description in English.

KABULIA Bor et Fisch., gen. nov.

A new genus of the *Caryophyllaceae* (*Illecebraceae*) related to *Cardionema* DC. (*Pentacaena* Bartl.), from which it can be easily distinguished by the alternate leaves, the perianth segments being 3 in number, 3 stamens, absence of staminodes, a strongly curved embryo and an ovary which is not contracted at the base. Species one.

KABULIA AKHTARII Bor et Fisch., spec. nov.

A caespitose HERB up to 2 cm. long. ROOT slender, up to 1.5 cm. long. Stems several from the base, very short. LEAVES alternate, closely distichous, acicular, 3-nerved, tipped with a pungent arista, 4.5—16.5 mm. long, green, finally turning red and deciduous with stipules, bracts, bracteoles, perianth and seed. STIPULES scarious, white, united into an ovate to ovate-lanceolate blade 4.5—5.5 mm. long, acuminate, with a tooth on either side above the middle. FLOWERS axillary, solitary. BRACTS 3 forming a quasi involucre, unequal, lanceolate to ovate-lanceolate, 4.5—5.5 mm. long, acuminate, variously toothed. BRACTEOLES 2, scarious, white, navicular, acuminate, winged on the back, 2 mm. long. PERIANTH LOBES 3, scarious, white, lanceolate, acute, 1.5 mm. long. STAMENS 3,

inserted on the base of the perianth lobes; filaments ensiform, 0.5 mm. long; anthers subglobose, 2-celled, purple. OVARY superior, ovoid in outline, narrowly elliptic in section with sharp edges, 0.7 mm. long, 1-celled; ovule solitary, erect, stipitate; style 0.2 mm. long, bifid for half its length; stigmas minute, capitate.

Fruit enveloped in the remains of the perianth, shining slate-grey in colour, ovate-obtuse in outline, 1.75 mm. long by 1.25 mm. at the widest part, bearing at the apex the remains of the style and stigmas. Wall of the ovary membranous, utricle-like, containing the seed. Seed orbicular or broadly elliptic in outline, biconvex in section, ending in a short thick blunt apical projection, very dark crimson in colour, covered with extremely minute, punctate, longitudinal striations; hilum basal; embryo curved in a vertical plane, cotyledons and radicle occupying the opposite margins of the seed, the intermediate space being filled with endosperm; cotyledons 2, about $\frac{3}{4}$ the length of the seed.

KABULIA AKHTARII Bor et Fisch.

1. Whole plant x 1.
2. Portion of the plant x 4.
3. Portion of the plant x 4.
4. Leaf and stipule x 6.
5. Bracts from outside x 6.
6. Flower x 20.
7. Perianth and stamens x 20
8. Utricle x 12.
9. Cross section of utricle x 12.
10. Seed x 12.

u = utricle.
e = endosperm.
c = cotyledons.
r = radicle.

SAL REGENERATION *DE NOVO*

BY E. A. SMYTHIES, C.I.E.

Summary.—This article discusses the various factors that influence *de novo sal* regeneration, and defines the optimum conditions in Bhabar *sal* for starting and developing such regeneration. Evidence is given to show that the final stage of the *sal* regeneration problem, *i.e.*, the *de novo* stage, is approaching solution.

Although the *Indian Forester* has been bombarded with articles on *sal* regeneration for the last quarter of a century or more, and although I have contributed articles every two or three years since 1920, I am venturing to write one more (which so far as I am concerned will be the last), dealing specifically with that part of the problem which, as earlier articles have shown, has so far eluded definite solution.

In my *Indian Forester* article of April 1936, I stated that "where *sal* whippy shoots already exist in the Bhabar Sal Working Circle in adequate numbers, I maintain without qualification or hesitation that the problem is already solved." Three years' further experience has amply confirmed this. We can now show, in fact we propose next year to show the Empire Forestry Conference, hundreds of acres of fairly pure crops of well stocked *sal* saplings 8 to 16 feet high, raised from 2 feet whippy seedlings within the last decade, one important factor in their rapid development being frequent rains shrub-cutting.

It was thus clearly recognised in 1936 that the problem of *sal* seedling regeneration had been narrowed down enormously, in fact the problem was to be able to guarantee adequate whippy growth 2 feet high when and where we wished. To quote again from the article of April 1936:

"The regeneration sequence would then be somewhat as follows:

(*i*) Convert a weed-infested, fully stocked mature *sal* crop into a somewhat more open crop with grass. Time, say, five years.

(*ii*) Adequate whippy *sal* recruitment to develop in the grass to about 2 feet high. Time, unknown; say x years. (This is the crux of the problem.)

(*iii*) Convert the 2 feet growth to 10 feet saplings by heavy fellings, fire-protection, shrub-cutting and where necessary a deer-fence. Time 5 to 7 years.

(*iv*) Final felling and removal of fence. Total period = 12 + x years from first felling."

For average U. P. Bhabar *sal* conditions, we have now ample evidence to prove (*i*) and (*iii*) of the above sequence, so I shall turn to (*ii*).

In considering *de novo* seedling regeneration, there are a number of different factors to be considered in some detail, *i.e.*, (*i*) soil conditions, (*ii*) seed production, (*iii*) climatic conditions, (*iv*) weed competition, (*v*) canopy, (*vi*) fire, (*vii*) browsing and grazing. Of these (*i*) to (*iv*) are fundamental, while (*v*) to (*vii*) are factors which we can control so as to influence favourably some of the fundamental factors.

(*i*) *Soil conditions*.—The Forest Research Institute Soil Chemist has not yet published the results of his researches, so no data of chemical or physical condition, or pH value, indicating favourable soil conditions, are yet available. There is, however, fortunately, another indicator which can be safely relied on to show when soil conditions are favourable or unfavourable for *de novo* regeneration, and that is the nature and intensity of *existing weed growth*. Thus, pure evergreen weeds and undergrowth are now accepted as indicating soil conditions hopeless for *sal* seedlings. Again, heavy waist-high pure grass growth (under strong shade) never seems to regenerate, and indicates poor drainage or waterlogging in the rains. On the other hand, a 50/50 mixture of light *Imperata* grass and *Clerodendron,* knee-high, is now definitely recognised as indicating favourable soil conditions for starting *sal* regeneration *de novo,* and as a point of practical silviculture, we manipulate our canopy, firing, and grazing (as will be explained later), to obtain this condition of weed growth. Having obtained it, the first stage will be reached for starting regeneration. (In point of fact, regeneration may start while this stage is being reached.)

(*ii*) *Seed production*.—This factor seldom fails or is a cause of failure to obtain regeneration. In the past quarter century, we have had bumper seed years, *i.e.*, when the whole *sal* forest produces flower and seed instead of a new flush of leaves, in 1913, 1918, 1923, 1926,

1929, 1933, 1936. In addition, partial intermediate seeding occurs frequently between the bumper years, and, in the course of a decade, we can safely count on sufficient seed production to regenerate an area two or three times over. But as we well recognise, adequate seed production does not necessarily mean adequate seedling production, as there are two further factors of immediate importance to be considered. One is a suitable germination bed for the seed to fall on. As Hole proved a generation ago, the leaf fall must be removed to enable the seeds to germinate on the mineral soil and not on a soggy blanket of fallen *sal* leaves. This can be done easily by a control burn in early April, and it is now standard procedure to burn P. B. I areas regularly before seed fall, wherever further *sal* recruitment is required. The other factor of immediate importance is climatic and beyond our control. This is discussed below.

(*iii*) *Climatic conditions.*—That the monsoon has a vital effect on seedling production, in two opposite ways, has long been recognised. There must be moisture and rain for the *sal* seed to germinate and the young seedling to survive. A delayed monsoon, or fierce windstorms blowing down the seed before the monsoon conditions set in, may nullify the seed production of a bumper year. On the other hand, persistent and heavy rain during July and August causes the young seedlings to damp off in millions in the moist good quality Bhabar forests (but not in the drier and poorer quality hill forests). A comparison between the 1913 and 1936 seed years clearly illustrates this point. Both were years of enormous seed production, in both the monsoon started early, giving ideal germination conditions, but the 1913 monsoon petered out (resulting in a famine year) while the 1936 monsoon was very strong throughout August. While 1913 was a record seedling year, 1936 was ultimately very disappointing. An early but weak monsoon seems the ideal for Bhabar *sal* forests.

(*iv*) *Weed competition.*—It is a curious phenomenon that, whereas in clear-felled plantations weed competition in the early stage is fatal and clean weeding is essential, under moderate or heavy canopy the presence of mild weed growth appears beneficial. In several recent experiments, germination and early survival in *clean weeded* strips under *sal* canopy has been very disappointing while adjoining natural unweeded seedlings, with rains shrub-cutting, have

survived. On the other hand, if the overhead canopy is opened too much, weed competition becomes excessive and, to a great extent, inhabits new (natural) seedling regeneration. Again, the state and composition of the weeds and ground cover is undoubtedly a very important factor in the early stages of regeneration as already indicated in (*i*) above. The Assam foresters of the Kamrup school were always striving to get back to "thatch" (*i.e., Imperata* grass) in evergreen infested areas, and we find the same necessity in the U. P. But it must be light thatch under moderate to fairly heavy canopy, and *not dense thatch in the open*. Our research (and other) experiments are giving definite indications of success where mild fellings have been made, and are promising to fail where heavy preliminary fellings have been made. I am convinced that the weed competition and the state of the weeds is a most important factor as well as a most important indicator, in the early stages of *de novo* regeneration, and that we must strive to get *the 50/50 mixture of light Imperata and Clerodendron, knee-high,* to achieve success.

The remaining three factors, *i.e.,* (*v*) canopy, (*vi*) fire, (*vii*) grazing and browsing, can be considered together, as I regard them chiefly as controls or aids to reach the optimum conditions of soil and weeds. The Conservator of Forests, Working Plan Circle, has summarised the matter very clearly in the 1938-39 U. P. Annual Research Report as follows:

> "The problem of obtaining *sal* regeneration *de novo* and getting it to persist and grow up to the whippy stage appears to be approaching solution. Experiments started six years ago have now progressed sufficiently for it to be possible to draw certain tentative conclusions, at any rate for the better Bhabar type of *sal*. Starting with a fairly mature *sal* forest, in which regeneration is absent, the best procedure appears to be as follows:
>
> (*a*) A moderate opening of the canopy (this will probably mean nearly one crown's width space between the crowns of the seed-bearers to be left, or say, leaving the seed-bearers about 30 to 40 feet apart). In areas of heavy undergrowth of an evergreen type it will probably be advisable to burn for several years before the felling.

(*b*) After the felling, cut the shrubs and burn in March/April as soon as the cut material is sufficiently dry to ensure an adequate burn.

(*c*) Continue burning annually (preceded, if necessary, by a shrub-cut if the area would not otherwise burn well) until a good seedling year occurs. It will then generally be advisable to shrub-cut and fire-protect for one, or, possibly, under certain conditions, for two years. There may, however, be occasions when fire protection is unnecessary after a good seedling year and annual burning can be continued without a break. Instances of this have occurred when the canopy was fairly dense and the undergrowth light, and sufficient one-year old seedlings were able to survive the burning, but it is believed that this will not often occur. After the one (or possibly two) years of fire protection continue burning annually until the next good seedling year (preceded by shrub-cutting if necessary, but taking care not to cut the shrubs under openings in the canopy so drastically that *Imperata* grass becomes predominant).

(*d*) Until sufficient regeneration has been obtained, each good seedling year should be followed by shrub-cutting and fire protection for at least one year unless, as explained above, exceptional conditions make it unnecessary.

(*e*) When an adequate amount of regeneration has reached the whippy stage, the proceedure outlined in paragraph 2 can be followed.

Until stage (*e*) has been reached game-proof fencing appears to be unnecessary, and is probably definitely harmful, as owing to the absence of browsing the shrub growth inside a fence is denser, and the increased suppression from shrubs is more harmful to small regeneration than the browsing that occurs in an unfenced area.

It is impossible at present to say how long it will take to reach stage (*e*), but it will probably be at least six or seven years, and may be as much as 12 to 15 years in unfavourable sites."

I should like to quote, as an example, the case of a compartment (Lakhmanmandi I, Haldwani division), where we have fairly complete information of canopy, weeds, state of regeneration, etc., for the past 20 years, and where the territorial staff have succeeded in obtaining nearly adequate *sal* regeneration *de novo* in the last 10 years (and mostly since 1933). In 1920 it was a densely stocked good quality sal forest (it is illustrated in Plate V, page 7 of Howard and Smythies' Sal Field Table, 1923), and the density of the overwood kept the ground comparatively bare of weeds and of regeneration. It was systematically burnt in April each year from 1922 to 1926, which, however, under the heavy canopy, led to slight erosion and no regeneraton. It was thinned out in 1926, and wind break (due to a fierce wind-storm) in 1927 further opened the canopy in small gaps, *i.e.*, a pepper-pot canopy. It was again burnt in 1928 and 1929, then completely protected for five years, 1930 to 1934, and again burnt regularly (and also shrubs cut) for the last five years, 1935 to 1939. In this particular area, seedling years have been 1926, *1929*, 1933, *1936*, *1937*, 1938, In 1925-26 the Working Plan Officer described the area as having no regeneration and little weed growth. In 1929 a fine crop of seedlings was obtained, but by 1934 these had survived only in the small gaps, and by then the *Clerodendron*, etc., after 5 years' protection plus opener canopy, were getting bad. In 1936 the Working Plan Officer described the area as having no established regeneration, but unestablished seedlings in the gaps (but none elsewhere). We have been lucky in having three good to fair seedling years in succession. The Divisional Forest Officer made a systematic examination of the compartment this year early in June, and while the weed growth is now almost ideal, he noted that 75 per cent. of the whole area has adequate whippy *sal* regeneration. (The overwood is again rather too dense, the stock being 60 stems per acre, averaging five feet girth.) Thus stage (*e*) of Conservator of Forests, Working Plan Circle's note, has nearly been reached in a comparatively short time. (Results would probably have been better still, if the canopy had been kept a little more open, it has closed up considerably since 1927. The removal of 10 or 15 stems per acre now,

combined with rains shrub-cutting, would do a great deal of good.) This area, managed by the territorial staff, as well as several research areas, giving comparable results, are definitely encouraging; they show we are on the right lines and lead us to hope that the final stage of the *sal* regeneration problem (*i.e.*, the *de novo* stage) is approaching solution for the well stocked Bhabar type of sal forests.

I should perhaps explain what we now mean by "adequate" whippy regeneration. In the Research experiments, in which indicator lines are statistically and periodically measured, the standard, to be adopted in future will be two seedlings per square yard 20 inches in height and over. When the research experiments were laid out in 1933, the standard for "established" regeneration was one stem 10 feet high per square of six feet. It illustrates the advance in our views of the problem that we now increase the number, but reduce the height to 20 inches! The production of one (or more) saplings 10 feet in height from eight seedlings 20 inches in height is no longer part of the problem for research; it is now applied in divisional practice on the working plan scale. A frequent feature of recent divisional regeneration operations which impresses the careful observer is that there appears to be considerable amount of "invisible" regeneration, *i.e.*, regeneration which has died back, or is almost leafless in the cold weather. the presence of which is not suspected, but which develops rapidly when the conditions of growth (opening of canopy, protection from weeds, etc.) are made favourable. A striking example was a five-acre plot, which I selected personally for a *de novo* experiment, that with opening of canopy and shrub-cutting was found to be 70 per cent. stocked with pre-existing regeneration, and it has in three years reached stage (*e*). This applies particularly (perhaps exclusively) to areas which have retrogressed due to too much canopy or too many weeds or other reasons, and where the root-stocks are often much more developed than the insignificant aerial shoots would suggest. All the best patches of *sal* saplings now showing up in the Lakhmanmandi plantation area developed from "invisible" regeneration.

11. To summarise the points of this article:

(*i*) The development of 10-foot saplings from 2-foot seedlings has passed out of the research stage, and is now carried out on the working plan scale.

(*ii*) With the optimum conditions of soil, weed growth and canopy (as defined) and with average luck in synchronising good seed years and good climatic conditions, adequate *de novo* regeneration may be expected to develop to the 20-inch stage within a reasonable time (say a decade).

(*iii*) The silvicultural measures considered best to produce the optimum conditions are indicated.

SOPAS OF LAKHIMPUR DIVISION (ASSAM)

By I. B. Roy, Forest Ranger, Assam.

Sopa is the local name for most of the species of *Magnoliaceæ*. In the Lakhimpur Division, the writer has found ten *Sopa* species so far, *viz.*, *Magnolia griffithii* (*Bor bahori Sopa*), *Magnolia pterocarpa* (*Thouthoa*), *Manglietia insignis* (*Pan Sopa*), *Talauma phellocarpa* (*Tita Sopa, Kharika Sopa*), *Talauma hodgsonii* (*Barhamthuri Sopa*), *Pachylarnax pleiocarpa* (*Kathalpatia Sopa, Kathalua Sopa*), *Michelia oblonga* (*phul Sopa, pani Sopa*), *Michelia montana* (*Kharipan Sopa*), *Michelia mannii* (*Kathal Sopa*), and another, specimens of which have been sent to the forest Botanist, Forest Research Institute, Dehra Dun, for identification. Of the above ten species, *Magnolia griffithii*, *Magnolia pterocarpa*, and *Talauma hodgsonii* do not grow to any large size, and are almost useless as timber producing species. The rest are valuable, and their timber is extensively used by the building contractors and cabinet markers.

While it was appreciated in the province that species of *Magnoliaceæ* were of value, little was known as regards the best methods of propagation. Any data recorded have noted that the percentage of germination was very small, and this probably deterred many from attempting to grow these species in plantations. Being greatly impressed by the rapid growth, fine shape, fragrant flowers, and valuable timber of some of the species, the writer began investigations in 1935 with a view to improving the percentage of germination and making the raising of such species a successful and economic proposition. The results of the investigations, carried out over a period of four years, have been very encouraging. While formerly the percentage of germination of *Talauma phellocarpa* and

Manglietia insignis was recorded as being 4 per cent. and 2 per cent. respectively, such figures have been raised to 28 per cent. and 40 per cent. respectively. As regards the other four valuable species, 66 per cent. germination for *Pachylarnax pleiocarpa,* 58 per cent. for *Michelia oblonga,* 15 per cent. for *Michelia montana* and 29 per cent. for *Michelia mannii* have been obtained without any special method of treatment except mixing the seeds with red lead for protection against ants, rats, etc. The progress of germination as found by the writer is recorded in the attached table.

Due to some unfavourable conditions prevailing near the *Talauma* bed, the germination of the species continued slowly up to March 1938 when about 25 per cent. was obtained. The normal result was, however, obtained in the following year when the germination was complete in December and the percentage was 28.

From the attached table it will be seen that the normal period and percentage of germination of the species are as follows:

Species	Period of Germination.	Percentage of Germination	Remarks.
T. PHELLOCARPA	October to December.	28	
M. INSIGNIS ..	Do.	40	
P. PLEIOCARPA ..	January to March	66	
M. OBLONGA ..	October to December	58	
M. MONTANA ..	November to February	15	
M. MANNII ..	Do.	29	

These percentages of germination make the species a suitable proposition for plantations. It is also quite likely that the percentages can be raised further by collecting seeds at the right time, sowing them as early as possible, and watering the beds properly every day. These are the essential points to be observed for successful germination.

The writer tried the soaking and drying method of treatment of the seeds with great success in 1937. The seeds were tied in pieces of thin cloth and kept immersed in water at night, and spread out in shade for drying during daytime, for seven days. They were then

sown in the nursery beds and watered regularly every day. The percentage of germination obtained is given below. There was no improvement in the period of germination.

Talauma phellocarpa	51
Pachylarnax pleiocarpa	77
Michelia oblonga	65
Michelia montana	53
Michelia mannii	46

Good *Manglietia insignis* seeds were not available for the experiment.

The same treatment of seeds was also tried in 1938, but the results were far less satisfactory than those obtained in 1937. The method deserves further trial.

Once germination has started, casualties are extremely few and the seedlings make rapid progress. Moreover, investigation has shown that one year old *Sopa* plants stand transplanting in winter (November-February) very well. Winter transplanting eliminates the first year's weedings altogether, and offers more favourable conditions to the plants than rain transplanting does. The writer is, therefore, of opinion that the proper method of raising *Sopa* plantations is to grow the seedlings in a central nursery where constant care can be taken, transfer them to the forest nursery in the proposed plantation area when about three inches long including the roots, and transplant the same with balls of earth during wet days of the following winter months. There is no reason why there should be failures if the technique is observed properly.

As data are not readily available regarding the *Magnoliaceæ* species, I give details regarding the six valuable species mentioned above. I have given details for *Manglietia insignis* as this is a very common *Sopa*. These data may be of interest to forest officers dealing with the same species.

In addition to their value as timber trees, the *Sopas* (except *T. phellocarpa*) are suitable for planting out along roadsides, etc. The Assam Oil Company have planted out many *Manglietia insignis* alongside their roads at Digboi. *Michelia montana* bears the most fragrant flowers, and *Pachylarnax pleiocarpa* has the nicest leaves among the *Sopas* of Lakhimpur Division. These two species deserve trial as avenue trees.

Further investigation is necessary as regards the *Magnoliaceæ* species and is being done by Dr. N. L. Bor, the Forest Botanist at Dehra Dun.

The writer is personally grateful to J. L. Harrison, Esq., I.F.S., late Divisional Forest Officer, Lakhimpur Division, for his keen interest in the investigations, and kind help in all possible directions.

NOTES ON MANGLIETIA INSIGNIS (*PAN SOPA*)

(*The treatment differs little for most of the species.*)

(1) *Locality.*—Found scattered in the plains and low hills on soils varying from sandy loam to clay.

(2) *Flower and seed time:*—Flowers in April-May; Seeds ripen in August-September.

(3) *Weight of seeds.*—About 15,000 to one seer.

(4) *Method of seed collection.*—Fruits should be collected from trees by lopping branches when the ripe carpels turn brownish and begin dehiscing, exposing the red pulp.

(5) *Method of treating seeds.*—The fruits should be dried in shade till the carpels open, after which the seeds should be removed by gentle thrashing and dried in shade after washing off the red pulp in water.

(6) *Method of seed storage.*—The seeds must be sown as early as possible and should not be stored for more than a fortnight.

(7) *Sowing.*—Seeds should be sown in lightly manured and shaded nursery beds in drills three inches apart with small quantities of earth sprinkled over them. If necessary, the seeds should be mixed with red lead to prevent attacks by red ants and rats. Ordinarily, spreading out of thatch or brushwood over the beds for quick germination should be avoided as this allures insects, ants,—even frogs. Six thousand good seeds, weighing about two-fifths of a seer, should be sown (after water test) in 20 drills, 300 seeds to a drill, in a bed measuring 12 by 6 feet. Such a bed is expected to supply a sufficient number of seedlings to plant up 1.5 acres, 6 by 6 feet, and extra plants for emergencies.

(8) *Germination.*—Germination starts within three weeks and is complete within three months from the date of sowing. Under unfavourable conditions, it may continue for a month or two longer.

The percentage is about 40.

(9) *Treatment in nursery.*—Watering must be done every evening up to germination, after which the beds are to be kept just moist and clear of all weeds.

When the seedlings are about three inches long, including the roots, they should be transferred (without earth) from the seed-beds to the forest nursery in the proposed plantation area and planted 6 by 6 inches. Under normal conditions no shades are necessary for such nurseries as small *Sopa* seedlings do quite well in the open, but they should be fenced in. The beds should be watered during drought and kept clear of weeds. From the month of June onwards, the seedlings will themselves suppress the weeds.

(10) *Method of transplanting.*—Rains transplanting (May—July) has the following disadvantages:

(1) Shelter crop of *Tephrosia candida* is necessary for protection of the plants against heat and weeds.

(2) Almost continuous weeding is necessary throughout the rainy season.

(3) Large percentage of casualties occurs among the transplants.

(4) Labour is difficult to get due to ploughing season and is less efficient on account of unfavourable weather conditions

To eliminate the above, the writer tried winter transplanting of the species in a small plot in 1936, with very encouraging results. The plants were one year old then. The casualty was practically nil, and the subsequent growth has been quite satisfactory. If the transplanting is done with balls of earth with the roots intact and the soil round the plants is thoroughly pressed down, casualties will be few and far between. It is hoped that the cost of winter transplanting will be less than that of rains transplanting by about rupees five per acre.

(11) *Treatment after transplanting.*—Nothing particular after winter transplanting.

(12) *Tending.*—Winter transplanting eliminates first year's tending altogether. Weeding is necessary in the second year. In the third and fourth year, no tending is necessary except creeper cutting. Thinning should be done in the fifth year.

(13) *Diseases and pests.*—The species is attacked by *Urostylis punctigera,* but not badly. The ripe seeds on trees are eaten by birds, and the sown seeds by ants and rats. The bark is damaged by deer. Such damage, if extensive, causes drying off of leaves and branches, even death.

(14) *Rate of growth.*—The species is the most rapid growing *Sopa* in earlier years. Average rate of height growth is given below:

1st year	... 4 feet 6 inches.
2nd year	... 9 feet.
3rd year	... 17 feet.

The highest three-year-old plant was found to be 21 feet.

(15) *Cost of plantation.*—The cost per acre of raising plantation of the species, planted 6 by 6 feet, is estimated as follows:

		Rs.	a.	p.
1.	Nursery	2	0	0
2.	Seed collection	1	0	0
3.	Pricking out (Forest nursery)	2	8	0
4.	Jungle clearing	7	8	0
5.	Burning and preparation of site ..	4	8	0
6.	Winter transplanting	12	0	0
7.	First year tending	0	0	0
8.	Second year tending	2	0	0
9.	Third year tending	0	12	0
10.	Fourth year tending	0	12	0
11.	Fifth year thinning	2	0	0
	Total	35	0	0

Considering the rapid growth of the species, the writer is of opinion that it should be planted 8 by 8 feet to reduce the cost.

(16) *General.*—It is an evergreen species about 80 feet in height and 7 feet in girth. The timber is used by builders and cabinet makers. Its foliage is pleasing to the eye, and flowers are comparatively large and fragrant. It is suitable for planting out along roadsides, etc.

Species	Date of collection of seed	Date of sowing	Date of first germination	Number of seeds sown	Number of seedlings on— 30-9-37	15-10-37	31-10-37	30-11-37	31-12-37	31-1-38	8-2-38	31-3-38	Remarks
Talauma phellocarpa	27-8-37	5-9-37	26-9-37	4,000	6	219	222	333					Germination continued slowly up to March 1938.
Manglietia insignis	26-8-37	4-9-37	1-10-37	4,000	..	728	1,340	1,610					Germination practically complete in November. In December only a few more seeds germinated.
Pachylarnax pleiocarpa.	2-10-37	18-10-37	20-1-38	1,500	..	..	..	..	..	14	352	1,003	Germination complete in March 1938.
Michelia oblonga ..	4-9-37	11-9-37	12-10-37	4,000	..	110	1,928	2,336					Germination practically complete in November. In December only a few more seeds germinated.
Michelia montana ..	10-9 37	14-9-37	29-11-37	300	..	..	..	1	Not counted	Not counted	44		Germination complete in February 1938.
Michelia mannii ..	10 and 20-9-37	14 and 23-9-37	19-11-37	600	..	..	..	4	do.	do.	175		do.

TIMBER TESTING IN INDIA

ANOGEISSUS PENDULA (*KARDHAI*) BREAKS WORLD RECORD

IN TOUGHNESS TESTS

BY V. D. LIMAYE, B.E. (MECH.)

Officer in Charge, Timber Testing Section, Forest Research Institute, Dehra Dun.

Summary.—Anogeissus pendula (kardhai) from the United Provinces is found to be the toughest timber so far tested at the Forest Research Institute, Dehra Dun, and, as far as we know, it has withstood a greater blow from a fifty pounds hammer than any other timber so far tested in any other laboratory in the world. Although it is a small tree, a considerable yearly output is available. The timber is, at present, used only for firewood and charcoal but it deserves more attention due to its valuable mechanical properties.

The toughness of any timber is found by allowing a heavy weight to drop from successively increasing heights on to the centre of a beam supported freely at both ends. The maximum drop registered before the beam breaks is the measure of its toughness. The standard test specimen is 2 by 2 by 30 inches freely supported on a span of 28 inches. A weight of 50 lbs. is lifted by an electro-magnet and allowed to drop freely under the action of gravity on the centre of the beam. The toughness testing machine in the Dehra Dun laboratory can give a blow from a maximum height of 76 inches. As no sign of breaking was visible at that drop when *Anogeissus pendula* was being tested, it was decided to change the falling weight to 100 lbs. One of the test specimens ultimately failed at a drop of 66 inches with the 100 lbs. hammer, which is equivalent to a maximum drop of *132 inches with the standard 50 lbs. hammer*. So far as I know, this breaks the world record. The average maximum drop for the species was 100 inches in the green condition. This places *Anogeissus pendula* as about the third toughest timber in the world.

Anogeissus pendula (*kardhai*) is a small, but important tree of the dry arid tracts of Rajputana where it grows on rocky hills. It also occupies extensive tracts of those divisions of the United Provinces, Gwalior and the Punjab which border on Rajputana. The maximum size of bole available is seldom more than three feet in girth and eight feet in length, the commercial size being only about 20 inches

girth (about six inches diameter) and five to six feet long. The crop is, at present, not tended for timber production as the major portion of the yield is utilised for firewood and charcoal making. Although the size is small, large quantities of small billets are available. It is probably, however, possible by systematic management to improve and substantially increase the yield of good timber.

General characteristics.—The heartwood is very small, irregular and blackish purple. Sapwood is wide, yellowish grey, practically straight-grained, smooth to the feel, and very fine-textured. The trees are very branchy. The wood is very heavy, with a weight of about 60 lbs. per cubic foot at 12 per cent. moisture content. It is a very hard, extremely tough and strong timber. *Anogeissus pendula* is, however, difficult to season as it splits badly. It is also liable to fine surface cracking. Sawing the billets through the centre into four sectors and very slow air drying by close piling is found to reduce the degrade considerably. Salt seasoning may also help to reduce splitting. Experiments on the proper methods of seasoning this timber are being carried out by the Seasoning Section.

As already stated, this species is mainly used at present for firewood and charcoal making, but from its strength and working qualities it seems to be a species having great potential value. It provides a very suitable timber for handles of all sorts, picker arms, wheel spokes, carts and poles, etc. It is worth trying for the manufacture of shuttles. Detailed investigations on its suitability for different purposes are being carried out at the Timber Testing Laboratory.

NATTAUNG, 1939

By B. E. Smythies

Nattaung (8,607 feet), the Mount Victoria of Eastern Burma, is the highest mountain on the Sittang—Salween divide; the boundaries of the South Toungoo and Thaton Forest Divisions and Karenni meet on its summit. Formerly it was very difficult to access, but the recently opened Mawchi Mines Road crosses one of its main ridges a few miles north of the summit. This, coupled with the fact that little work had been done on the avifauna of this part of Burma and none so far as was known on Nattaung itself, inspired the idea of an expedition there in the April holidays. The personnel, consisting of Mr. H.

C. Smith, Conservator of Forests, Sittang Circle, Mr. P. F. Garthwaite, Forest Entomologist, and the writer, assembled at Toungoo on the evening of April 6th, and spent the next day in sorting and packing kit ready for an early start on the 8th. Our transport consisted of a lorry for our kit and servants, and a Rangoon taxi for ourselves and dogs. Our thanks are due to the Divisional Forest Officer, South Toungoo Division, for making preliminary arrangements.

An expedition that was carried through without a hitch would be no expedition: it would be a Cook's tour. So that the breakdown at mile 36 of our taxi was taken in good part. The driver strove manfully by blowing into the petrol tank to overcome the wilfulness of a faulty connection, but each "inspiration" only maintained the flow for a few furlongs; after about the fourth stoppage we jumped a lorry, on top of which we completed the journey. The fool who said that it is better to travel hopefully than to arrive can never have been heartily bounced up and down on a lorry-load of petrol tins for 40 odd miles in the midday sun. However, our view of Nattaung, towering massively to the south-east, and later our entry into the pine zone did much to alleviate the roughness of the passage.

The Mawchi road is a fine piece of engineering. After crossing the Thaukyegat, at mile 23 or so, the remaining 66 miles lie through very steep and difficult country. To one accustomed to the rounded contours of the English and Scottish hills, the disadvantages of an immature and unglaciated topography soon become obvious; the sharp spurs and numerous acute-angled re-entrant *nullahs* make the road a very tortuous and winding affair; at a guess the distance by road from the Thaukyegat to Mawchi is not far short of three times the distance in an air line.

To a forest officer the journey is depressing. He travels through hundreds of square miles of forest devastated by the *taungya* cutter; it is only at elevations above 5,500 feet that much of the original forest remains. It would be interesting to know to what extent *taungya* cutting has always been carried on in these hills and whether the population has increased much in the last half century. It looks as if the Karens are having to shorten their **ponzo* rotation, so that the forest has no chance to recover between successive burnings and is reverting to an open savannah type in consequence. It is a pity

* Regrowth on abandoned *Taungyas*.

Burma-Assam Pine Forest at 7,000 feet.
Photo: P. F. Garthwaite.

"Rhododendron Ridge"
Summit of Nattaung, in the background, covered with Wet Temperate Forest.
Photo: B. E. Smythies.

that *taungya* cutting, a very wasteful method of crop production, has not been discarded in favour of some method capable of sustaining a much larger population per acre, such as the terraced cultivation of the Kumaon Himalayas. It is possible that the Karens may be driven to some such method to save themselves from starvation after they have completely ruined the forest. The various stages in the regression from hill evergreen, the natural climax dominant for the area, to the subclimax of open savannah under the influence of the biotic factor would make an interesting study in plant ecology.

Our base camp was a two-roomed bungalow at Pwado, which the Mawchi Mines Company kindly gave us permission to use: it is situated on a spur of Nattaung at about 5,000 feet, on the edge of pine forest with *ponzos* below and virgin forest above: an excellent centre for birds. We arrived there at 3 p.m. and a jorum of tea, brewed in a dog's bowl over a sweet smelling fire of pine chips, did much to banish the fatigue of the journey. Our kit arriving soon after, we spent the last two hours of daylight in a first look round.

Our original plan was to move camp on the 10th to somewhere near the top of Nattaung, but as the 25 coolies that we had been assured were ready for us failed to appear, the plan had to be modified. The 9th was spent exploring round Pwado, and the 10th was devoted to a do-or-die attempt on the summit of Nattaung, taking with us as tiffin carriers and guides the three coolies who had rolled up.

From the bungalow the route followed down the Mawchi Road for a mile, climbed steeply for a thousand feet, and dropped the same distance to the Lezi Chaung: a sparkling brook running over a bed of granite boulders. The southward facing slopes of its valley were clad with beautiful pine woods through which we had descended, and these were balanced by the sombre hue of the giant evergreen on the northward facing slopes: as typical a coombe as you will find in any corner of Exmoor. We christened it the "Happy Valley."

Leaving the stream we started a long 3,000 feet pull straight up the north face of Nattaung. At 6,000 feet we found a tree, later identified as Myrica nagi, Thunb., bearing an edible fruit with a pleasant acid flavour, in appearance not unlike a raspberry but with a hard centre. A few yards further on we came to an almost level

space of several acres in extent in the dense evergreen: the sort of place that Tilman aptly describes as "a horizontal oasis in a vertical desert." At one end near a small stream there was an enormous boulder the size of a cottage, with an overhang under which one could shelter; we christened it "Kyauk-mo."* Continuing up the ridge, the angle grew ever steeper. At about 7,000 feet we called a brief halt and sustained our flagging energies with apples and raisins; not as yet acclimatised, the height was beginning to make itself felt. The last 1,000 feet were at an angle of nearly 45 degrees and the slippery carpet of smooth shiny evergreen leaves made the climb strenuous and exasperating. However we reached the crest at last and soon found ourselves walking along a steep-sided granite ridge on which *rhododendrons* were flowering profusely under an open canopy of pines. This was the Toungoo—Karenni boundary ridge, and we felt that the summit, which now loomed close, was ours. The path dipped for 200 feet and climbed the last 800 feet through temperate forest, under which grew a dense thicket of a single-stemmed bamboo that was new to us. It was impossible to see through this for more than a few yards, and as the ridge is in places ill-defined it might prove difficult to hit off the summit without a guide.

It was 1-15 p.m. when we eventually reached the top. The vegetation had been cleared by a Survey of India party earlier in the year. One weather-beaten old holly tree had been left as a landmark (it can be clearly seen with glasses from the half-way halt on the Mawchi Road). Owing to the hot weather haze the visibility was restricted to about 30 miles. In clear weather the view is said to be devoid of dominant landmarks; Nattaung towers so much above the surrounding hills that the eye wanders restlessly over the ranges without finding anything to hold its attention. We saw no mountains of striking form, and the only things that stood out in the landscape were the Mawchi Road and the corrugated iron roofs of Mawchi surrounded by the detritus of the mines.

In omitting to take any water with us we made an elementary mistake. We had been told that there was a spring near the top, but on investigation it proved to have dried up; after a hot and thirsty climb we had but a cup of water apiece, not the steaming

* "Rock shelter."

jorum of tea that we had intended, wherewith to slake our thirst. After a brief rest we started down, sending a man on ahead to boil a pot of water at Kyauk-mo.

It is curious how tastes differ, especially when it comes to drinking tea. When really thirsty, one member of the party, who normally despises milk, delights in lashings of condensed milk, whereas the writer, who normally takes milk but no sugar, reverts to the habit learnt in Austrian huts of tea and sugar but no milk. *Chacun à son goût*. A few glow-worms lighted us on our way when we eventually made camp in the first of the starlight. As we sank another enormous brew of tea, suitably laced, we reflected on a very successful day; the weather had been perfect, we had bagged our peak, and we had collected and studied a number of interesting high elevation birds that were new to all of us.

On the 11th we made our way by different routes to the Happy Valley, where we assembled for breakfast. After choosing and clearing a camp site, we returned to the base camp by different routes, exploring all the likely bird haunts. On the next day, sufficient coolies having at last been mustered, camp was moved to the Happy Valley, while Smith made another ascent to the Rhododendron Ridge, and Peter and I worked the Happy Valley and the Kolo Chaung.

The 13th was another memorable day. Peter and I set off early for another ascent of Nattaung, an easy day from our new camp. The 3,000 feet climb to Rhododendron Ridge was done in under two hours, including stops to look at birds. We were now acclimatised, and topped the ridge in better condition to appreciate its beauties than we had been on the 9th. We noted two varieties of *rhododendron*: one was a red *rhododendron*, tall and woody, which flowers earlier in the year, and on which we only saw one or two belated blossoms; the other was the glory of the Ridge, a small variety in full bloom with large, white flowers, forming a dense thicket four feet to six feet high under the pines. A few of the bushes had flowers of white streaked with pink.

For half an hour we lazed about, taking photographs and enjoying the freshness of the morning. If you would breathe "champagne air" of Swiss quality, sit on an 8,000 feet pine ridge that has been warmed an hour or two in the sun when there is a gentle breeze

blowing across it, and inhale your fill. It is the combination of cool sweet air with the aroma of warm resin that marks the genuine vintage.

We continued slowly, stopping every now and then to listen and look for birds. Arrived at the top, we scrutinised Sosiso (about 7,500 feet), a peak five miles south-east of Nattaung and connected with it by the Thaton—Karenni boundary ridge. It has several acres of grass round its summit, and was the only hill in sight with a bare top. As it is only a knoll standing 100 feet or so above the main ridge, to call it a peak is perhaps misleading. It looked an interesting place, and as the Karens said that there was a tarn near the top round which we hoped to find game tracks, it was decided to climb it on the morrow. Returning slowly down, stopping at likely places for birds, we reached camp just before dusk.

The next morning we made our customary start at the crack of dawn, taking with us "Eddie"—an even dirtier specimen than the usual filthy hill Karen—as our guide. Both on Nattaung and on Sosiso the guides we took did us very well, except that "Eddie" started badly by marching us to the top of a 1,000 feet ridge and, like the Grand Old Duke of York, marching us down again, when there was an excellent path round the foot of it. The Karen believes in Euclid's definition of the shortest distance between two points, no matter what mountains may lie between: accustomed as he is to 45-degree slopes, he no doubt finds walking on the flat as irksome as we find his slippery hill-sides. We crossed the Kolo Chaung a little before 7 a.m., and then climbed about 1,500 feet on to Himalaya Ridge, stopping on the way at a small spring to fill up with water: we were taking no risks this time and each of the three tiffin carriers was made to carry up a bamboo section holding nearly a gallon. For four or five miles we followed the crest of a magnificent pine ridge, slowly, collecting as we went; the ridge climbed gradually with occasional dips, sharpening to a knife edge for the last mile. Here we looked down on several thousand feet of very steep pine-clad slopes, none of your stunted, useless specimens such as one had always pictured the Burmese pines to be, but really fine timber trees seven feet and more in girth and 60 feet to the first branch: fit to rival most of the Chir pine forests of the Himalayas that I have seen. The existing area of pine forest in Karenni is

probably small, but reservation and proper management would greatly improve the stocking and an annual yield that would be worth extracting might result. What a welcome variety a little coniferous forestry would give to the monotonous round of teak!

Just before midday we reached the Thaton—Karenni boundary, where we again struck the temperate forest and the dense thickets of bamboo that grow on Nattaung; through this we followed the ridge down for over a mile until suddenly we emerged from the twilight into open grassy spaces. We had not tasted food for eight hours; lacking even the energy to climb to the top we settled down to our rations and our customary jorum of tea. It is only when, in Bishop Blougram's words, "the body gets its sop and holds its noise" that the mind takes an interest in other things.

Many Karen legends centre round Sosiso. We found two or three small earthworks, like grouse butts on a moor, said to be old shrines at which the Karens used to make offerings; there were also traces of a graded path, now disused. From the shrines there is a clear view of the massive south face of Nattaung, wave on wave of dense jungle falling to the headwaters of the Yunzalin Chaung. *Rhododendrons* blossom round the summit, but to a Devonian the greatest find was a genuine "wort" or whortleberry in fruit (*Vaccinium* sp.), very like its Dartmoor cousin and making the same blue stain on the fingers when picked; it had gone to seed, but we ate a fruit or two for luck.

We were cheated of our tarn. We had dreamed of a Connemara jewel and we had expected a mud wallow. Both guesses were wrong, for the tarn had dried up. Smith found traces of a tiger: that was the only sign of animal life, apart from two parties of gibbons, a party of pig-tailed monkeys and a few (very few) squirrels, during the whole expedition. There is little doubt that the mammals have been shot or trapped to extinction by the Karens.

We left shortly before 3 p.m. and made our way unhurriedly down, sending a man on ahead to brew tea at the first spring. As we went down Himalaya Ridge the play of the evening light on the pine needles tempted several photographs. We made a brief halt for tea, which we found at 5 p.m., and then continued at our best pace in the failing light. Darkness overtook us just before we reached

the Kolo Chaung, and we walked the last hour in the light of aromatic pine torches.

That was a longish day—15 hours—but not so much longer than any other day. The primrose path of dalliance was not for us. Up at 4-15 of a morning and ready to start with the first of the light, we usually took our breakfast with us and did not return until dusk. The evenings were devoted to identifying and labelling specimens and writing up notes on habits, song, and visual records, for as long as we could keep awake. *Po-laungs** we had always with us. As hungry as Highland midges and twice as virulent, they gave us little peace in the daylight hours: it was impossible to sit anywhere for more than a few minutes to study birds without being severely bitten. However, no ill effects were experienced apart from a certain amount of swelling.

And what of the birds for whose benefit we worked so hard? Before you can do any work of scientific value on birds, you must know their names; for this reason the expedition was mainly concerned with identifying the Nattaung avifauna. Dr. C. B. Ticehurst, the leading authority (in the world) on Burmese birds, has examined and named the specimens, which he says will form a very useful addition to the British Museum collection. The scientific results are being published separately. Having got your birds correctly named, you can proceed to the more interesting business of studying them in the field. A start was made with this work and the calls and habits of several birds, about which there was no previous information, were recorded; we hope to concentrate on this next year.

The 15th was spent in moving back to our base camp at Pwado, and on the 16th, after a morning in the field, we spent the whole afternoon and evening packing up specimens, completing our notes and making ready for an early start on the morrow for the long drive to Toungoo.

Smith had prophesied continuous rain and hail for days on end as the least we could expect in the way of weather. The fact that we enjoyed glorious weather the whole time does not so much reflect on Smith as a weather prophet—for it is remarkable to escape rain throughout the April holidays—as indicate that we had the traditional luck of beginners: one also likes to think that the Nats regarded our visit as a pilgrimage to their Olympus, and were pleased. On

* Blood-blister flies.

this last morning, with the high tops enveloped in cloud, it looked as if we were in for rain, but it came to nothing and the journey was uneventful. Even the taxi went well, and the driver only had to do his inspiration stunt twice to get us down. Our return to the dust and sweat of the plains was cheered by the morning's memory of the clouds pouring over Nattaung, as the camper in Rothiemurchus on many a summer's day may see them pouring and dissolving over the summits of Braeriach and Cairngorm.

NOTE ON THE FOREST TYPES OF NATTAUNG

The nomenclature adopted here is that used by Champion in "A preliminary survey of the forest types of India and Burma," Indian Forest Records, Vol. I, No. 1.

Four climax types and two seral types occur on Nattaung.

1. (*Group 1a, c2*) *Eastern Tropical Evergreen.*—A variety of this, known in Burma as "Hill Evergreen," occupies steep North-facing slopes from 5,000—8,000 feet, and also moist pockets and stream sides in the other types. The following is a summary of Champion's description:

"Lofty dense evergreen forests 150 feet or more high . . . the canopy extremely dense . . . epiphytes are numerous . . . ground vegetation in typical cases may be almost absent; elsewhere a carpet of *Strobilanthes* or *Selaginella* and ferns may occur; grasses are absent . . . erect bamboos are unusual but may occur locally."

1*a*. (*E9*) *Southern Wet Bamboo Brakes.*—This is found in small patches here and there in the evergreen. "Bamboo brakes are usually found along streams or on badly hollows more or less displacing the tree forest . . . the brakes are often very dense, even if the bamboos grow in clumps."

2. (*Group 7b, c3*) *Assam-Burma Sub-Tropical Hill Forest.*—This type is a buffer between the pine forest and the evergreen: it grades into temperate forest (see below) at about 6,000 feet. "Hill forest of good height and density, the dominant species being mostly evergreen though some briefly deciduous trees occur. The total canopy density is much less dense than in the tropical evergreen.

and the large trees rarely stand close together. A shrubby undergrowth is always present and grass is absent. Bamboos may be present or not . . . the type is characterised by the prevalence of oaks and chestnuts, *Quercus* and *Castanopsis*."

3. (*Group* 8, *c*2) *Assam-Burma Pine Forest.*—This occurs on south and east facing slopes between 4,500 and 8,000 feet, and covers large areas, but is restricted to well drained soil. It is probably a stable edaphic climax. "Typically a practically pure association of pine (*Pinus khasya*) but very generally influenced by the annual or periodic fires which take place. Typically no other trees occur; there is practically no underwood, and even shrubs are few, but where the moisture conditions are a little more favourable there tends to be an underwood of *Quercus* and other broad-leaved trees. These trees, mostly evergreen species, increase with rising altitude, leaving the pine on the warmer, drier ridges and as scattered standards. A grassy soil cover is usual and climbers and bamboos are absent."

3*a*. (2*S*/2) *Burma Sub-Tropical Hill Savannah.*—"Grassy downs with scattered clumps or single trees, usually pine and oaks."

This type occurs only as a small area of a few acres on the top of Sosiso.

4. (*Group* 10*b*, *c*2) *Assam-Burma Wet Temperate Forest.*—The higher slopes of Nattaung, above about 6,000 feet, are covered by this type, with a few outliers of pine forest and evergreen; it is like a dwarf form of oak forest with which it intergrades, and is distinguished by low rounded crowns and short boles, dense bamboo undergrowth (*Arundinaria elegans* Kurz), and alpine elements in the flora.

"Closed evergreen high forest of trees of large girth but medium height, rarely over 80 feet, and usually with large branching crowns festooned with mosses and larger epiphytes . . . at the high elevations a dwarf bamboo undergrowth is very generaly developed and may be very dense and uniform over large areas." Oaks and chestnuts are prevalent; *Rhododendron* (sp. ?) occurs in the pine forest outliers over 7,000 feet.

TIMBER PRICE LIST, AUGUST-SEPTEMBER 1939
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 36-0-0 to 42-0-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 50-0-0 to 61-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Rs. 0-9-0 to 1-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-6-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-12-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-10-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-2-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 53-2-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 42-3-0 to 51-9-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 80-0-0 to 100-0-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 31-4-0 to 48-7-0 per ton.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 60-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 37-8-0 to 45-5-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers ..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 62-8-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-8-0 to 1-3-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-8-0 to 5-0-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 1-10-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs	Re. 1-2-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Re. 0-14-0 to 1-2-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-12-0 to 0-14-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-12-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Re. 1-0-0 per scantling.
,, ..	,, ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	Re. 0-11-0 to 1-0-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Re. 0-12-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-13-3 to 2-4-2 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-8-4 to 3-1-4 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 85-0-0 to 137-8-0 per ton.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

REVIEWS AND ABSTRACTS

"THE GROWTH, STRUCTURE AND PROPERTIES OF WOOD"

Forest Products Special Report No. 5. Published by H. M. Stationery Office. 9d. net.

This Special Report, issued by the Department of Scientific and Industrial Research, summarises the principal conclusions reached in systematic investigations carried out at Forest Products Research Laboratory and elsewhere, on the structure of wood in relation to physical and mechanical properties on the one hand, and to conditions of growth on the other.

It is hardly possible to work with timber for any length of time without being impressed by the individual character of each species and the variety of figure to which wood owes so much of its charm. At the same time, however, comes the realisation that the variations in density, strength, and machining properties are such that no two pieces are exactly alike, and are sometimes apt to place wood at a disadvantage in competition with other industrial materials. Within the limits of a single species the variations are due largely to growth factors which influence the development of the anatomical and submicroscopic structure of the growing tree, and ultimately determine the properties of the wood. The anatomical structure of wood thus forms an important link between growth and utilisation.

Growth rate, the proportion of summerwood in the growth rings, and specific gravity have often been regarded as the most useful indications of the strength of timber and the emphasis given to these features in some of the earlier publications on the subject has seemed to imply that if only the relationships were studied in sufficient detail these features might be used as satisfactory guides to wood properties. Studies of several typical hardwoods have shown, however, that these factors may account for less than half the variation encountered in some strength properties, and that in some material the physico-chemical composition of the fibre walls may have a greater influence on strength than all the other factors put together.

Up to the present it has not been possible to define the variations in cell wall composition in either chemical or physical terms, but they are distinctly recognisable by means of the standard histological reagents of the botanist, and some indications have been obtained of the types of growth condition responsible for them. It has been found, for instance, that the condition of the cell wall that makes for a high resistance to longitudinal compression is dependent on climate and that, on the whole tropical timbers are stronger in this respect than temperate timbers. Resistance to shock appears to behave in the reverse manner, the temperate zone timbers being tougher than tropical timbers, weight for weight. The composition of the wood substance is also influenced by quite small deviations of the tree from the vertical. In sloping trees there are important differences in strength, shrinkage, and machining properties between the wood from the upper and lower sides, and these differences have been traced to the composition of the fibre walls.

A BOOK ON BUTTERFLIES

THE FAUNA OF BRITISH INDIA, BUTTERFLIES, VOL. I, 2ND EDITION

By G. Talbot; London, 1939, pp. i—xxix, 1—600, Plates I—III, 1 map, 184 text-figures, Price 35 shillings.

It takes all sorts to make a world of butterfly collectors. They range from school-boys in the hills to Viceroys; from people who argue with Kim in the *Statesman* on the uselessness of Latin names for butterflies to generals who regiment the races, sub-species and varieties with super-military precision and nomenclature. They include ecstatic souls like those of Friedrich Schnack and his translator Winifred Katzin, who ask:

> "Of what dim intimations are they the luminous word? It may be they have brought us down the colours of the Paradise we lost, perhaps that was the earth from which they drew their roots, as the gates fell to, which shut us out for ever . . . an angel sent a host of butterflies to follow us into exile . . . lilies whose gold we bartered for our folly's dress . . . abandoned speedwell . . . the clover of good omen gambled away . . . timeless sunflowers!"

As well as the editor of an *Indian Natural History Society's* Journal who more realistically observes that:

> "*Euthalia garuda,* in spite of its silken raiment, seems to prefer the liquid from the foulest gutter to the nectar held in the chalice of the fairest bloom."

It takes all sorts of entomologists also, for there are some to whom a butterfly matters merely as a migrant, or because it is bitten by a bird. And there is the novice who spoils more specimens than he sets, as well as the veteran who deplores the low trend of prices fetched by aberrations at Stevens' Auction Rooms.

Nor can the forester escape inclusion in this motley and ignore butterflies as things of no account; for many more species than he realises are pests of his plantations. Should our prologue have caught his eye, we hope it will introduce him to the latest project for a comprehensive reference work on the butterflies of India, Burma and Ceylon—a revision published in the *Fauna of British India* series.

The present volume deals only with the *Papilionidae* and *Pieridae,* nearly 200 species out of the 1,443 species recorded from the Indian region; it will probably require four more volumes to complete the monograph. As a *Fauna of British India* production, it is definitely intended for the entomologist and the serious collector, who intends to devote many years to his hobby. There are plenty of less pretentious handbooks for the less ambitious collector.

The *Fauna* volume contains general accounts of the ecology and life-history, morphology, classification, variation, geographical distribution, methods of collecting and preserving, a glossary, bibliography, a map, 184 text-figures and three coloured plates. The general introduction is most informative and no similar account is to be found in any single entomological text-book. The illustrations are derived from a variety of sources and include several prepared by T. R. D. Bell, I.F.S., of Karwar and his sister.

The author states that all available information on the habits and life-history of the species has been incorporated but we notice some omissions from the economic literature; we suggest that a list of food plants, with the species of butterflies feeding on each, would be a useful addition to the last volume.

The effect of the food plant and the season on local races and the sequence of generations is a subject that needs further examination. The generalisation that "in the Himalayas most butterflies have two broods . . . in the rest of India butterflies are on the wing all the year round" scarcely agrees with modern observations.

C. F. C. B.

EXTRACTS

CANADIAN TIMBER

Devastation or Conservation?—The Question of Future Supplies

The time cannot be far distant when the forestry and timber producing interests of Canada will have to get together in real earnest to tackle the problem of ensuring the maintenance of one of the Dominion's greatest assets. To the visitor from this side making a first personal acquaintance with, say, British Columbia, the observable timber wealth of the Pacific Coast area is, to put it mildly, staggering. To proceed 20 miles into the forest to see a modern logging operation in progress is staggering also. High-lead logging leaves behind it a scene that strikes the layman as one of utter devastation.

It is generally admitted that Canadian thought and action applied to the forestry industry have a good way to travel before they get into any sort of alignment with that of other countries where forest conservation and the question of sustained yield have for years been regarded as matters of paramount importance. The position in Canada is graphically summed up this week in an article by Mr. H. R. MacMillan, the well-known B. C. shipper, in the Canadian Supplement of *The Daily Telegraph and Morning Post,* who tells of the beginning of Canada's industrial history when Napoleon's continental policy forced Great Britain to turn to the forests of the St. Lawrence Valley for masts and deals previously procured from the Baltic.

The industry in Canada moved West as the forests of the Eastern areas of the Atlantic neared exhaustion, and, as we know, the harvesting of the British Columbia forest has now become a major industrial operation.

The virgin forest, says Mr. MacMillan, is rapidly falling before a mass attack. One of the larger logging companies will clear 3,000 acres of the finest timber land yearly, and about 100,000 acres are fed into the machines every year in British Columbia!

From that point it is an easy stage to the two questions which are so frequently heard, namely: "How long can it last?" and "What of the future?"

Serious Overcutting

Mr. MacMillan declares that Canadians have listened to such tales of Canada's limitless resources that they are prone to avoid the answer rather than seek it. The national attitude is that of Micawber—something will turn up. Meantime the greatest problem is unemployment, which could only be increased if any limits were set to the crop to be annually harvested.

Meanwhile, concludes the writer, it is generally known among the well informed that the forest is being overcut at a devastating rate in every forest province in Canada; that Canada, an essentially forest country, lags far behind India, the United States, Norway, Sweden, Finland and France in forest policy; and that forest schools and forest departments in Canada are half-starved and failing to lead or influence a Canadian people who are still bent on exploitation rather than conservation of their great natural resources.

Clearly, serious attention to the problem mentioned by this prominent B. C. producer is imperative. When action will be taken and what form it will take we do not know; but when the subject was broached in conversation in B. C. last year, it was made evident that forest experts and members of the timber industry were in general agreement that "something should be done about it."

Timber Growing Industry still in its Infancy

In his treatise on the forest resources of British Columbia, Mr. F. D. Mulholland, Forester in the Forest Surveys and Working Plans Division of the British Columbia Forest Service, deals with the question of growth, depletion and possibilities of sustained yield. He declares that on the great stands of mature or over-mature timber which have accumulated in the Coast forests, the forest industries have been built up with little or no thought for their replacement,

because stocks were so immense that possibility of a shortage was altogether too remote. Also loggers have been for the most part tenants interested only in the mature timber, leaving consideration for a second crop to the Crown, the landlord who has been chiefly concerned with making the natural resources support the cost of development of a new country.

For these reasons, he says, not only are the products now being taken from the British Columbia forests the result of Nature's unaided work, but also the growth upon which we depend for future supplies is in such natural reforestation as has succeeded without silvicultural attention. The logging and milling industries of British Columbia are highly organised and efficient, but the timber growing industry is in its infancy.

The period required to grow merchantable trees depends upon the quality of timber which has a commercial value. "We know that in 100 to 120 years we can grow Douglas fir saw timber of fairly good quality for building material," adds the writer, "but will people need or want that kind of material even half a century hence, or will, say, 60-year-old trees meet their requirements? There is already reason to believe that the familiar methods of the saw-mill will become obsolete in the march of progress. If we are confident that such small trees will support the industries of the future, then we can be more free in our cutting of the virgin stands than if we have to wait for 100-year-old trees to grow.

"Coast Douglas fir, our chief export species since export began, is now being cut from trees two, three or more centuries old at the rate of $1\frac{1}{2}$ billion board feet a year. The volume of this species remaining on the Coast is only 37 billion feet, more than half of which is inaccessible under present conditions, and there is an entirely inadequate area of middle-aged fir. It is obvious that the export industry will have to turn to other species. Fortunately, there are also large stocks of mature hemlock and cedar of excellent quality. When these are gone, Coast industry will be dependent upon the second growth."

Summarising, Mr. Mulholland declares that on the Coast not only is reforestation unsatisfactory, but the rapid expansion of industries is making it apparent that it will be impossible to avoid a

conflict between the desire of private interests to utilise all the mature stands as quickly as markets can be found for the timber, and the public interest which requires that great basic industries dependent upon natural resources should be regulated on a permanent basis. Increased effort should be made to conserve the remaining virgin timber by reduction of waste, because the Coast forests are now being overcut in relation to the rate of replacement by growth. In the interior, local regulation of the cut is needed, but the more urgent requirement there is better protection from fire and insect damage.

No accurate forecast can be made as to future conditions in world markets, foreign tariffs, logging engineering, new inventions in the use of fibre and cellulose, the development of new industries, decrees of population and increased consumption of wood products. It would be unreasonable, in Mr. Mulholland's view, to attempt to restrict utilisation of the forests to their capacity for accessible sustained yield of merely the quality of products which B. C. industries and markets are now taking; to do so would mean a reduction of output from the past 10 years' average of 2,541,000 M.b.m., worth $63,308,300 to 1,557,000 M.b.m.; but it would be reckless to exploit the accessible forest resources without limit, on the unproved belief that the next generation will not need the products of old growth timber and that quickly grown trees and forests now accessible will meet the demand.

Towards "Flexible Regulation"

"Somewhere in between, thinking always a little ahead of conditions of the day, as these conditions change, those responsible for British Columbia's forests can develop a flexible policy of forest regulation," he adds. "Its success or failure will depend upon the good judgement and ability of those who develop it: upon the accuracy of their forecasts of future developments; upon the extent of their regard for the interests of future generations in comparison with the importance they attach to the satisfaction of present desires."—*The Timber Trades Journal*, Vol. CXLIX, No. 3274. 27th May 1939.

CLOSED

Not even Lord Erskine's apologia can excuse the Government's decision to close the Forest College at Coimbatore. To speak of its closure as being forced upon the Government by the need for economy is to convince no one. Such financial stringency as now restricts the Government's activities is largely, if not wholly, of their own making, and the new taxation measures already approved by the Legislature and assented to by His Excellency are expected to more than make good the amount necessary to balance the budget.

In his speech at the final prize-giving at the Forest College yesterday, Lord Erskine gave an excellent exposition of the value of forests to this province. Their destruction would have the direst results upon agricultural lands, and would mean increasing loss to the Government and people. Yet though, as everyone knows, the Forest Department is compelled to wage a constant war against attempts, mainly the result of ignorance, to do things which would inevitably destroy this Presidency's valuable forests, the Government have decided that the proper training of its forest guardians may be entrusted to some remote—and so unsuitable—a centre as Dehra Dun. All the arguments which led to the opening of the Coimbatore Forest College have been forgotten, and a makeshift arrangement, the defects of which were admitted yesterday, has been adopted. And the saving effected is less than a fraction of the profit made by the Forest Department each year.

The Chief Conservator of Forests, speaking at the prize-giving, paid a tribute to the Minister in Charge of Forests. But surely that tribute would have been more richly earned had Mr. Muniswami Pillai made a bigger fight to save the College. One so fully acquainted with the value of forests as he might rightly be expected to make a stand for their preservation. So while we welcome Mr. Wilson's evidence of growing appreciation of the true value of forests to this Presidency, we cannot but deplore the fact that this appreciation has yet to develop sufficiently to end all controversy over the need for every effort and wise spending to preserve our forests.—*The Madras Mail*, Madras, dated July 1, 1939.

NEPAL'S FORESTS

According to a recent Lucknow message, the Nepal Government have under consideration a project of far-reaching significance not only for their own country but for India. They contemplate setting up a properly constituted modern Forest Department. The Kashmir Durbar recently did so, and the Nepal authorities apparently have been impressed by the need for comparable action within their own borders. If this news is accurate, it merits a very cordial welcome. There are reasons for profound uneasiness regarding the linked questions of deforestation, soil erosion, and flood prevention in the central Himalayan region and adjacent alluvial plain, and without some degree of co-operation between India and Nepal effective remedial measures must remain difficult to devise. The issues at stake are most important—far more so than those implicit in the ephemeral political controversies which engage so predominantly large a share of the public's attention. Nothing less than the future prosperity of the populations numbering hundreds of millions depends upon the maintenance, throughout the Gangetic basin, of a proper balance between the constructive and destructive forces of Nature. If, through the depredations of mankind, petty individually yet large in their cumulative effects, the scales should once be tipped beyond a certain danger-point, appalling devastative processes would be unleashed. Continuous and uncontrollable thinning of the massive vegetation draping the high hills, profoundly deleterious climatic changes, gulley-formation and swift extension of the hideous *chos* desert, widespread loss by wind and water of rich soils both in the hills and valleys, and disastrous sudden floodings over vast areas would inevitably ensue, and the fertility of one of the earth's potentially most productive regions be permanently impaired.

Of the intimacy of the connections between the irrigation engineer's problems and those of the forest officer and soil expert there is now far livelier official recognition, the obviously encroaching danger having doubtless acted as a spur. Welcome evidence of a less departmentalised attitude of mind was discernible at last year's meeting of the Central Board of Irrigation in Delhi and again at the illuminating Inter-Provincial Flood Prevention Conference held in Lucknow during January, and a good deal of desultory discussion

has lately been heard of the need for setting up some form of Central organisation to deal with the entire complexes of subjects broadly and impartially. Unfortunately, the several problems are not confined in scope to British India; political issues of some intricacy are involved in them, since they have wide geographical ramifications, not only in several Indian States, but in Nepal.

How vitally important a position that independent kingdom occupies is often overlooked by those who have not a good memory for maps. The bearing of deforestation in the mountainous Kumaon division of British India on flood-prevention has been much debated, and the need stressed for protecting the remaining tracts of unreserved forest which it contains. Yet by crow's flight from the foothills above Pilibhit to the Tehri-Garhwal border, Kumaon is only 150 miles broad—less than a third the span of Nepal. From east to west that rigorously exclusive country extends for over 500 miles—a distance greater than the maximum measurement across Bengal from Darjeeling to beyond Cox's Bazar—and within it lie some of the loftiest and most profusely watered ranges of the Himalaya. What precisely is happening to the magnificent forests within all the countless convolutions of its foothills no man can with certainty say; but the symptoms of a progressive deterioration seem unmistakable. If this formidable process can be checked by the creation of an up-to-date Forest Department armed with adequate powers, the long-term benefits to humanity will assuredly be very great. Any move towards the establishment of such an organisation on the part of the Nepal Government is deserving of India's unqualified gratitude and support.—*The Statesman, Saturday, May 27, 1939.*

FORESTRY IN INDIA

Certain aspects of forestry on which the Duke of Kent laid emphasis at the Empire Forestry Conference held in London early this month deserve attention in this country. The Duke of Kent's reference to forestry in India was complimentary, perhaps even complacent. "Not everywhere in the Empire," His Royal Highness observed, "has systematic afforestation been as successful as in India." This may be a fact, but an impartial student would have no hesitation to say of India what the Duke has said as being true of many

parts of the Empire, that "prevention of erosion has become one of the main problems of the forestry departments." If in the past in this country, conservation has been allowed to suffer in the name of exploitation and in the interests of revenue, in later days, Indian forest policy has laid itself open to the charge that in the name of conservation, the people were not allowed to enjoy the full benefits of the country's forest areas. The ideal of forestry which the Duke laid down is noteworthy. "The first aim of any forest policy," His Royal Highness is reported to have stated, "must be to render the country as far as possible independent of foreign supplies of timber, and the first call on forests must inevitably be the domestic requirements of the inhabitants, both for the protection of their agricultural lands and the supply of forest products." It cannot be pretended that from these points of view, Indian forestry is adequately efficient. Our imports of timber continue to be on a considerable scale every year; while the cry of the agriculturist is perpetual that he does not get either fodder for his cattle or manure for his fields in sufficient quantities at reasonable prices. The Report of the Royal Commission on Agriculture shows that this complaint of the agriculturists is not ill grounded.

The case for a forward forest policy is to-day too strong, and recognised to be such by the authorities, to need detailing at any length. Of the economic value of wood at all times, there can be no two opinions; wood remains, as His Royal Highness the President of the Conference pointed out, one of the indispensable articles of mankind; substitutes for wood are found, but as experience has shown, no sooner are they found than fresh uses for timber are also discovered. The pamphlets which the Forest Utilisation Branch of the Dehra Dun Institute have been issuing from time to time give an idea of the possibilities of Indian timber in furnishing articles of everyday use to the citizen at moderate cost. Another aspect of forestry is the provision of soft woods or substitutes therefor in adequate quantities so as to enable the country to become self-sufficient in respect of pulp and other essentials. The great growth of population in the country in recent times has had effects on forests which have to be closely studied. The advances made in the knowledge of forestry have shown that if the best results are to be obtained, there should be a balance between cultivated area and area under forest

and that if the process of denudation of forests is allowed to proceed at a pace which is calculated to disturb that balance, then it will have climatological and other reactions on the country's economy detrimental to human welfare. This means that, as the Duke of Kent pointed out, it is only by educating public opinion in the necessity for control to ensure continued supplies that the difficulty of extraction of forest products could be met.

In other words, one of the cardinal points in a well-formulated forest policy will be provision for developing "a forest-conscience"—a point on which His Royal Highness dwelt at some length. This is necessary not merely to enable the State forests to be scientifically managed under any system of administration which is democratic but also to get the many thousands of acres of private forests controlled in such a way as to make them subserve the nation's interests at large. One of the recent developments in European forests is the use to which they are being increasingly put as the nation's recreation ground and arena of sport. This, as the Duke of Kent pointed out, is a great benefit "which is becoming more and more evident with the growth in motor transport." One great advantage of this new-found use of forests has been the opportunity it has given the public of appreciating the tremendous value of forests leading to the developing of a "forest-conscience." Forest departments in India have not hitherto done anything to encourage the public to take advantage of the forests for this purpose. We hope it will not be long before they profit by this line of development in Europe.—*The Hindu*, Madras, dated June 26, 1939.

NOTICE

Manual of Indian Timbers

BY J. S. GAMBLE.

Copies of this book, which is a reprint of the second edition with some corrections and additions, printed in 1922 by Messrs. Sampson Low, Marston and Company, Ltd., London, are available for sale at the Forest Research Institute at the reduced price of Rs. 5 per copy only excluding postage charges.

The price has been purposely reduced in order to clear out the stock of this useful and handy book.

Forest Officers and others who wish to buy the book should send their requirements to the President, Forest Research Institute and College, New Forest P. O., Dehra Dun.

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons)					
	MONTH OF JULY			4 MONTHS, 1ST APRIL TO 31st JULY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	1	209	10	361	618	30
French Indo-China ..	..	1,673	1,228	690	2,327	2,014
Burma ..	12,334	14,957	11,173	54,567	51,148	46,366
Java ..	600	43	224	1,189	967	1,356
Other countries ..	105	..	..	492	10	..
Total ..	13,040	16,882	12,635	57,299	55,070	49,766
Other than Teak—						
Softwoods ..	2,125	1,286	1,000	6,839	5,835	4,948
Matchwoods ..	1,072	624	909	4,267	3,777	3,912
Unspecified (value)						
Firewood ..	41	69	22	240	226	172
Sandalwood ..	30	20	6	55	46	36
Total ..	3,268	1,999	1,937	11,401	9,884	9,068
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..		..	..	..	..	..
Sleepers of wood ..	14	4	159	91	133	438
Plywood (tons) ..	552	337	755	2,238	2,045	2,814
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	..	..	..	..	..	..
Total Volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	33,509	33,015	11,619	86,342	116,694	54,017

Seaborne Trade and Navigation of British India for June 1939 :

IMPORTS

ARTICLES	VALUE (Rupees)					
	MONTH OF JULY			4 MONTHS, 1ST APRIL TO 31st JULY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	130	23,169	1,112	41,250	79,951	3,336
French Indo-China..	..	2,04,286	1,31,563	74,583	2,80,433	2,19,280
Burma ..	15,16,709	18,42,693	13,14,548	67,25,733	68.34.961	58,25,040
Java ..	80,164	6,220	22,949	1,50,807	1,04,472	1,40,434
Other countries ..	11,076	..	..	53,485	806	..
Total ..	16,08,079	20,76,363	14,70,172	70,45,858	73,00,623	61,88,090
Other than Teak—						
Softwoods ..	1,73,446	94,317	63,300	5,07,815	4,43,632	3 25,064
Matchwoods ..	57,316	44,509	65,505	2,52,363	2,53,013	2,79,749
Unspecified (value)						
Firewood ..	615	1,039	330	3,597	3,372	2,590
Sandalwood ..	11,449	9,577	3,900	18,383	13,329	9,858
Total ..	..	..	..	..	..	..
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	..	..	..	..	..	..
Sleepers of wood ..	1,622	800	17,009	13,638	19,186	54,320
Plywood (tons) ..	1,01,911	81,258	1,37,370	4,83,501	4,44,131	5,25,784
Other manufactures of wood (value) ..	1,61,135	1,54,791	1,35,898	6,38,280	5,66,839	5,43,300
Total ..	..	..	..	..	..	..
Total value of Wood and Timber ..	2,295,985	27,98,805	20,54,376	97,82,097	1,01,95,082	88,92,822
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	2,76,466	2,97,654	80,100	6,69,710	11,25,637	4,30,384

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF JULY			4 MONTHS, 1ST APRIL TO 31st JULY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom ..	40	..	..	65	..	20
,, Germany ..	..	..	..	..	1	..
,, Iraq ..	14	50	22	85	108	41
,, Ceylon ..	..	..	..	..	1	30
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries ..	67	187	247	230	558	757
Total ..	121	237	269	380	668	848
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	3	..	..
Unspecified (value) Firewood ..	..	..	..	115	..	..
Total ..	..	..	..	118	..	..
Sandalwood—						
To United Kingdom	..	10	..	2	11	..
,, Japan ..	5	..	..	6	4	51
,, United States of America ..	..	..	16	167	135	36
,, Other countries	47	8	17	172	41	100
Total ..	52	18	33	347	191	187
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	No data			No data		
Total value of Wood and Timber ..	No data			No data		
Other Products of Wood and Timber	No data			No data		

EXPORTS

ARTICLES	VALUE (RUPEES)					
	MONTH OF JULY			4 MONTHS, 1ST APRIL TO 31ST JULY		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom..	6,156	..	..	9,838	..	2,600
,, Germany ..	..	..	..	..	150	..
,, Iraq ..	3,145	15,514	4,575	17,731	34,576	9 427
,, Ceylon ..	..	45	..	..	154	2,145
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	18,947	63,767	57,147	60,719	1,85,922	1,43,341
Total ..	28,248	79,326	61,722	88,288	2,20,802	1,57,513
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	72	..	840	72	..
Unspecified (value) Firewood ..	..	..	..	1,027	..	..
Total ..	..	72	..	1,867	72	..
Sandalwood—						
To United Kingdom	..	12 000	..	2,6?0	12,375	..
,, Japan ..	6,000	..	..	6,600	3,973	54,025
,, United States of America ..	..	..	17 610	1.66.040	1,42,000	38,110
,, Other countries	45,437	7 905	13,245	1,76,393	44,577	96,542
Total ..	51,437	19,905	30 855	3,51,633	2,02,925	1,87,677
Manufactures of Woods and Timber other than Furniture and Cabinetware (value)	26,112	45,675	8.473	79.757	1,33,662	96,337
Total value of Wood and Timber ..	1,82.186	1,76,681	1.06.725	12,71,460	6,54,716	5,46,814
Other Products of Wood and Timber	No data			No data		

INDIAN FORESTER

NOVEMBER 1939

3RD SEPTEMBER 1939

Foresters deal with things that endure. Their eyes are ever upon the future, not only for the next generation but for many succeeding generations. Forestry ideally should be free from the relatively ephemeral concerns of current politics. There are, however, certain times of grave importance when politics disappear and principles alone remain: certain immutable principles, certain precepts of fundamental value, with which those who practise forestry, as is the case with all other branches of human endeavour, are essentially concerned. Of these perhaps the greatest, because it is probably the most difficult, is freedom. This journal, which for more than 60 years, has been the mouthpiece of foresters in India, may, therefore, be pardoned for a short departure from its normal technical bent in order to reproduce a few extracts from a speech which was made by Lord Baldwin, then Mr. Stanley Baldwin, Prime Minister of Britain, as long ago as 1926. These extracts seem clearly apposite to-day and perhaps particularly so in India:

"It has often struck me, in trying to lay my finger on the difficulties and danger-spots of the present day—and that, of course, is one of my duties—that among the many causes of present discontent you may put this: We are living in an age in which there has been a greater development of all kinds than there has ever been in a similar space of time in past ages. In this century alone we have seen the development of motors, telephones, of gramophones, of enormously increased use of electricity for industry and in the home, and, last and most wonderful of all, the development of wireless, which is still in its infancy. And it is perfectly natural, when people see such progress being made in the various fields of human effort and human life, that they feel there must be some short cut to a general improvement in our material conditions and in the relationships of human

life. It is most natural, but it is fallacious. . . . You will find that the greatest enemy you have to combat is ignorance, and you will find that, just as ever since the world began there have always been many men who have looked out for an easy way to get their livelihood, so you will find to-day, until you have helped to succeed in dispelling that ignorance, a large number of people who will obtain a profitable livelihood by exploiting that ignorance and preying on it. As I have often said, we are moving along in this country—possibly in others, but certainly at home; we are moving along by a process of evolution into conditions and relations of life in industry and socially which will be very different from those which existed in the last century and in previous centuries.

There is no prophet who can predict the ultimate form into which these relations will come. But we do know that you are more likely to obtain better conditions in this country by pursuing certain paths than by pursuing others, and the condition of the generation ahead of us for the next thirty years must depend very largely on the work that you and others like you do in this country. The future is in your own hands, and you have to realise that these years in which we are living, the years into which we are entering, are going to be, as no years before have ever been, the real testing time of democracy. Real democracy lay ahead of them. We are in it now, and we are going to advance into it more; and I think myself it is a good sign that so many people are taking the keenest interest in politics.

Of course, according to our view, many people take the wrong interest in them. But if that be so, that is all the more reason that we should take the right view and try to teach them better, because, after all, whatever democracy may have to show as the years of the century go on, it can only be determined, as I said five minutes ago, by what you and your contemporaries make of it. There has never been in this world a perfect instance of democracy at work, and, therefore, all the greater is your responsibility. We in this country may make a fearful mess of it; and if we make a mess of it, we shall get something much worse—we shall get a tyranny of

some kind or other. I don't know what form of tyranny it may be. It may be the Communist tyranny; it may be tyranny from the other end. But if you cannot evolve a sound and sane democracy, that will be the fate of the country.

If I were to be asked what two of the root principles are which we should always keep in view in trying to decide on a political issue, in judging of legislation, in judging of political action, I think I should say common-sense and the preservation of what has always been the most precious thing in this country—individual freedom. If you apply these two tests, you will seldom go far wrong. There are many people to-day who think that you can cure the ills of the world by legislation: but you must examine the legislation they propose to see whether it is adapted to the practical experience of daily life, whether the freedom of the individual is affected by it. And if you cannot be satisfied on these points, you may be quite sure that that legislation in the long run will do more harm that it will do good.

And so I would urge you all to think for yourselves, to think clearly and accurately and fairly. And remember that there always has been in this country in the past the right of the individual to earn his own living in his own way and to do what he pleases with his life, provided always that he does nothing to injure any other man. I spoke the other day about foreign ideas and influences being at work in this country, and I said I have no objection to ideas because they are foreign, but I did feel this: that the conception of freedom in our country was one so precious, so hallowed, it has been obtained as the result of such age-long struggles, that I feel convinced that in no other country—whatever advantages in other respects they may have over us—in no other country was freedom treasured and regarded as it was in this country, and in its attainment there was no country in the world that had anything which in all circumstances it could teach us. That I believe to be absolutely true, and if you study the history of our country from the earliest days you will find that, whatever mistakes we have made, whatever we have suffered from, there are no two things so alien to our people as tyranny and intimidation. Neither of them has ever taken root in England nor I believe ever will.

* * * *

"This is a testing time for democracy. The future of our country and of our Empire both together equally depend on how the ordinary man and woman of the country and the Empire, those into whose hands political power has been committed, those whose hands can guide and steer the ship—it all depends on how they are going to use that power. I am convinced myself that the intentions of the people of this country are to use that power well. But in managing things in this world you want to bring in head and heart, and I want you who are amply dowered with both to mingle with your enthusiasm knowledge as time goes on, and experience, so that in your work you may speak of what you know, and that you may make your influence felt, the influence of speech, the influence of persuasion, and, above all, the influence of your own lives as citizens in this great country. Then when the time comes that those of us who have been speaking to you this evening are gone, when our work is finished, you may be able to look on your own work and feel that it is good, and that you are handing on to your children and to your children's children a tradition still better and still finer than that which we were enabled to hand down to you."

SAFEGUARDING THE "SAFEGUARDING FORMULA"

By M. V. Laurie

Silviculturist, Forest Research Institute, Dehra Dun.

In regulating the yield in a selection system or any other irregular system two considerations have to be taken into account, namely: —

(*a*) The forest must not be over-felled in terms of the total increment it is putting on, and, if the forest as a whole is understocked or has a depleted growing capital, intentional under-felling may be necessary so as to enable the growing stock to be built up.

(*b*) The yield of selection trees must be maintained.

Smythies has shown (1) that yields calculated in terms of the total productivity of the forest by formulæ such as Von Mantel or

its modifications may, in cases where the growing stock is abnormal, lead to over-felling among the selection trees and a shortage of trees of exploitable size in the future after one or two felling cycles. In order to maintain the yield of selection trees, Smythies devised his "safeguarding formula" which maintains constant the stocking of trees over an arbitrary diameter limit.

This formula fulfils consideration (*b*) above, but it does not by any means guarantee that the forest as a whole may not suffer from overfelling especially in the particular type of abnormal distribution of age classes that is so common in selection forests in India,—namely where, on account of past exploitation, there is already a relative shortage of trees in the mature classes. By the example given below I propose to illustrate the danger in applying the "Safeguarding Formula" by itself and to indicate the necessity for a further safeguard in the form of a limiting figure for the yield that is based upon the total increment of the growing stock. I do not, in what follows, intend to imply that the usefulness of Smythies' formula is in any way diminished. I merely wish to demonstrate that sources of danger of over-felling exist that have, perhaps, not been fully appreciated hitherto, and necessitate the adoption of further safeguards.

The utility and application of the "safeguarding formula" have been fully discussed by the originator in the *Indian Forester* (1), (2), (3) and need not be recapitulated here. The formula merely aims at maintaining the number of trees in the exploitable class constant by removing a number of them equivalent to the number passing up from below. The formula is:—

$$Y = \frac{f}{t}\,(\mathrm{II} - z\%\ \text{of II})\ \text{when}$$

Y = the yield

f = felling cycle

t = average period taken for a II Class tree to pass over into the I (exploitable) Class.

z = mortality per cent., or the percentage of II trees that disappear in t years.

II = number of trees in the diameter class immediately below the exploitable diameter class.

It is a very modified form of Brandis's method of regulating the yield and is based entirely on the stocking of the II Class of trees.

Brandis's method takes into consideration the normality of stocking of the I (exploitable) Class also, and the rate of passage of trees is based on a consideration of the stocking of all the smaller diameter classes.

An imperfect knowledge of the correct values to use for *t* and *z* constitutes a source of error that is well-known and recognised. Hitherto these factors have usually been estimated from yield table figures for regular crops, and are, therefore, not strictly applicable to irregular systems. In any particular forest, conditions of mortality and of diameter growth as affected by the density of stocking may be very different from those in fully stocked regular forests, and serious errors may occur. Steps are now being taken to collect more accurate data for *t* and *z* by means of linear tree increment plots, many miles of which have been recently laid out in the more important sal forests of the United Provinces.

A much more serious source of error, however, the magnitude of which does not appear to have been fully appreciated, is that due to incorrect fixing of the diameter limit for exploitation. A typical instance of this came up recently in connection with the revision of the Lansdowne division working plan for sal in the United Provinces. Enumerations of the growing stock showed the following distribution of trees in the different diameter classes:

Diameter class.		*No. of trees.*
12″—16″	...	62,783
16″—20″	...	23,463
20″—24″	...	6,908
24″ and over	...	3,358

This distribution, while being very abnormal in respect of our ideas of normality in a selection forest, is typical of the condition of many forests in India that have had their larger diameter classes depleted by past exploitation, and is, therefore, a very fair example to give.

The average times (t) taken for II Class trees to pass up into I Class trees are, for different diameter limits, as follows (taken from the sal yield table):

Exploitable diameter limit 16″ ... $t = 26$ years.
20″ ... $t = 29$ years.
24″ ... $t = 32$ years.

(These, being taken from a yield table for regular evenaged crops are, of course, not strictly correct, but they will do for the present illustration.)

The mortality per cents (z) have been estimated (also from the yield table) at 41%, 36% and 29% respectively.

The yields for a felling cycle of 15 years are therefore:

For 16″ diameter limit – $Y = \frac{15}{26}(62{,}783 \times 0{\cdot}59)$
$= 21{,}400$ trees.

For 18″ diameter limit
(all figures interpolated) $Y = \frac{15}{27{\cdot}5}(39{,}400 \times 0{\cdot}62)$
$= 13{,}300$ trees.

For 20″ diameter limit $Y = \frac{15}{29}(23{,}473 \times 0{\cdot}64)$
$= 7{,}400$ trees.

For 24″ diameter limit $Y = \frac{15}{32}(6{,}908 \times 0{\cdot}71)$
$= 2{,}290$ trees.

It is thus seen that an increase in the exploitable diameter from only 16″ to 18″ gives a reduction in yield of 33.2% (almost ⅓rd) while an increase from 16″ to 20″ gives a reduction of 14,000 trees or 62%.

In working plans for irregular forest the exploitable diameter is generally an arbitrary figure in so far as its connection with the stocking of the forest and the diameter class distribution is concerned. It is usually fixed on the basis of the size (sometimes even the lowest size) that is readily exploitable or that is large enough for efficient conversion into sawn material. It may be very much a matter of opinion whether it should be 16″, 18″ or 20″ on this basis, and hence whether the annual yield should be 21,000 trees, 13,000 trees or only 7,400 trees, as calculated by Smythies' formula.

Many forests in India are in a similar state of abnormality to that exemplified above. Instances have recently been seen from

Orissa and the Central Provinces and similar cases are repeatedly coming to light. Smythies does on occasion make provision for adjusting the yield by multiplying by an arbitrary factor of $\pm$ A (1) when the stocking of the I Class trees is abnormal, but in the example given above this correction was not made. The low diameter limit of 16″ was fixed which is very likely to cause over-felling and a reduction in total stocking and hence in total increment.

Although Smythies' formula may be successful in maintaining the *status quo* in the number of trees of the exploitable class, the arbitrary fixation or alteration of the exploitable diameter may cause wide variations in the yield some of which may involve serious over-felling or under-felling. The formula will only work properly by itself if—

(*i*) a correct knowledge is available regarding the best exploitable diameter in respect of the value increment curve of the crop, and this knowledge is at the present time, generally lacking,

(*ii*) if the number of trees in Class II is normal in respect of the distribution of the age classes,

(*iii*) if accurate figures are available for t and z. This information is also usually very sketchy, and serious errors may be introduced.

At the present time the errors arising from an imperfect knowledge of the above factors and from an arbitrary fixation of the diameter limit are usually so great that this formula is likely to be of little value by itself as a method of regulating the yield.

Our aim is everywhere to improve and build up the productivity of our forests, and not to deplete it. In the example given above, the calculated yield bears no relation to the increment of the forest as a whole, and if the exploitable diameter has been fixed too low, the growing capital will be reduced below its present level down to what might be considered normal for that diameter. The fact that a reduction in total mean annual increment (apart from considerations of price increment) would occur indicates that the diameter limit is probably lower than that which would be the most paying (*i.e.*, than that which, in normally stocked forest, would give the maximum annual net revenue). In order to avoid this

danger, some consideration of total increment must be taken into account, and the following procedure is suggested to overcome the dangers of overfelling by fixing too low an exploitable diameter limit.

The yield should first be calculated by one of the modifications of Von Mantel's formula as applied to partial enumerations. Then by a study of the forest and the distribution of the diameter classes it should be decided whether the forest is fully stocked and is apparently producing its maximum possible increment or whether any improvement in increment is likely to be possible. If, as will generally be the case in India, this examination shows that the increment of the forest as a whole is likely to be lower than normal, then the figure given by Von Mantel or whatever method is used should be arbitrarily reduced so as to permit of the growing stock being built up. This arbitrarily reduced yield should be regarded as the lowest safe minimum, and should be used as a limiting check on any yield worked out for the particular distribution of the size classes in and around the selection class. Having this limiting check and also having collected data on which to determine the most paying exploitable diameter one can then apply Smythies' formula as a check to ensure that the stock of I Class trees will not run short in the first few felling cycles. Thus two yields are calculated, one by Von Mantel's and the other by Smythies' formula. Whichever of the two represents the smaller volume of timber should be adopted, though occasionally some compromise may perhaps in special circumstances be permissible.

It is, thus, necessary to safeguard the results of the application of Smythies' formula by a yield figure based on the productivity of the forest as a whole.

I have not mentioned another source of error in application of Smythies' formula and all other formulæ for the yield in selection fellings. I shall not go into the matter in detail but just draw attention to the fact that in marking in sal forests, very often a considerable number of trees are not silviculturally available, and may, on account of lack of regeneration to take their place or for other reasons, not become silviculturally available for several felling cycles. It is impossible to discriminate in enumerations so as to exclude these trees, and consequently an arbitrary

reduction of the calculated yield must be made to allow for them in each coupe when marked. Failure to make allowance for this is regarded by some authorities as one of the most serious sources of damage in the application of a calculated yield to sal forests managed by selection methods.

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CAN BENGAL CLAIM COMPENSATION FOR HER FLOODS?

BY Y. S. AHMAD

Go to the east, go to the west, whether to the north or to the south, everywhere the same cry, "Flood and Relief," "Flood and Relief." What has happened to Bengal? The Bengal which was the land of rivers and greenery, a land of bounty which produced not only enough for her own people but could be most charitable to the rest of India. Has this land which was the source of inspiration of some of the greatest poets of the east gone altogether bankrupt? Bengal's floods of recent years form a most serious problem which is not only exercising the Government but the whole country, rich or poor, high or low. Lacs and lacs of Government money are being spent for the relief of the distressed, but this relief, though expensive, is only of a temporary nature. Therefore, unless the problem is tackled at its very root, it will make no appreciable difference to the situation and this land of agricultural plenty will surely and steadily become an uninhabitable desert.

The probable causes of flood are described below. It is for the politicians and legal authorities to adjudge the blame but I hope they will all agree with me that it is not due to the fault of the Bengalees that we are suffering from this annual scourge.

The four main river systems that irrigate Bengal are (1) the Ganges from the Himalayas in the United Provinces; (2) the Brahmaputra from the Himalayas in Assam; (3) the Meghna from the Manipur, Cachar, Lushai and Khasia Jainti hills in Assam; and (4) the Damodar from the Vindya hills in Bihar. These four-river systems, which formerly brought down fresh silt for the fertile plains of Bengal and flushed and cleaned the whole province, now bring down destruction and desolation. It is admitted that the people of the neighbouring provinces, through which these rivers flow, also suffer. But their suffering bears no comparison to the universal misery of the villagers throughout the length and breadth of Bengal.

A glance at the rainfall chart of the Meteorological Department will convince the most sceptic that the annual rainfall has not altered very greatly in the last few decades. Yet the rivers seem to bring down much larger quantities of water every year. These quickly flood over the whole country, but as soon as the rains are over, the rivers go dry. The villagers who live a life afloat in the rains, as if in a vast sea, find themselves in desert conditions in the dry season and in consequence suffer extreme privations for want of water. The floods not only sweep away the agricultural crops from the fields but also carry away large numbers of cattle and sometimes even the houses from the villages, leaving only waste and desolation behind them. A careful study of the causes of flood will show that their effects are not difficult to follow.

It is common knowledge that the rivers in Bengal, and in fact throughout India, begin to rise from about the middle of May. The reason is that with the advent of summer and the heat, the snow on the hills, specially above 9,000 feet elevation, begins to melt and the resultant water flows down the streams, increasing their volume. The process goes on at an accelerated rate as the year advances. The floods, however, do not occur till the rains break. If the total annual rainfall has not increased, it is obvious that there is something wrong. The rain water is no longer held up in the catchment areas of these rivers and carried deep into the soil by seepage. The underground springs are no longer fed, instead all the rain water flows down in one great rush into the rivers, overflowing all their banks till ultimately it falls into the sea. This is

not all, seepage having fallen off, the underground springs are deprived of a steady supply of water, so that after the rains these, in their turn, are unable to feed the streams and rivers, which consequently go dry. Very few people realise that this process actually results from the misdemeanour of a handful of hill people, who form an insignificant proportion compared to the millions who suffer from the effects of the floods down in the plains. Yet Government in every province has played a special role of "Ma-Bap" to the hill tribes and given them unlimited latitude to play about with the land in any way they liked.

The almost universal form of cultivation on the hills is, what is commonly known as "Jhuming." The hill people are far too lazy to adopt a system of permanent cultivation which requires deep hoeing and manuring the soil. They therefore move their cultivation from site to site every year or every second or third year if fresh land is difficult to get. The hill slopes, which were originally clad with a mantle of forest trees, are felled and cleared in the cold weather. From the end of February to March the felled trees are burnt. The fire and smoke on the hill slopes at this time of the year can be seen from miles around. On this cleared and burnt area a few inches below the surface small quantities of grain seeds are put in a notch made by a pointed stick or the tip of a *dao*. The virgin soil of the hill slope, enriched by humus under the forest and the wood ash from the burnt vegetable matter, produces a bumper crop to the great satisfaction of the hill people. In the following rains, due to sheet erosion, the surface soil is removed, the productivity falls off and these hill-side cultivators move on to fresh areas of forest.

In a hill covered by forest trees, the rain, ere it falls on the ground, strikes the leaves and this retards the force of the rain. The ground, too, made porous by the roots of trees and the burrowings of animals and insects, enables the dripping rain to trickle down into the springs deep under the ground. Further, the humus or the layer of vegetable matter on the surface of the forest soil acts as a sponge, holds the rain water and maintains a continuous supply to the springs. Later, when it rains very heavily and the saturation point is reached by the humus, the excess water of the rain runs into the channels and streams. For this reason, in the olden days,

it was only when the rainy season was well advanced, in August-September, when the agricultural crops in the fields of the plains were sufficiently grown, that the rivers reached their highest level for the year. The rise of the flood was generally gradual, the rivers were systematically fed by the springs, there was no dearth of water after the rains, agriculture was successful and the country was happy and prosperous.

But with the forest cleared, the humus and vegetable matter burnt to ashes, the insects destroyed and the hill slopes cultivated with crops, the rain water strikes directly on the ground with its full force, rushes down the channels and streams and carries down first the surface soil and later the boulders and subsoil which are deposited in the rivers below. The fine particles of soil washed down by rain water are first laid on the surface of the soil in the plains like a plaster of cement. This sediment clogs up all the pores in the soil, the water cannot percolate into the ground and the subsequent deposition of sand and boulders gradually raises the bed of the rivers. Lowdermilk has demonstrated, by experiments in America, by introducing 2% of sediment into water and making this mixture percolate through a soil surface, that the rate of percolation falls off 90% in six hours as compared with clear water; and reverting to the use of clean water does not accelerate it afresh. When the seepage or percolation of water through the soil falls off rapidly, more water is forced into the channels and streams.

As a result of these extensive fellings on the hills, large volumes of water go down the streams immediately after the rain. Their volume is further increased by the boulders they carry and the reduced areas of the river-beds cannot hold the water which consequently floods over the banks, washing away first the young agricultural crop and later even carrying cattle and houses with it. into the sea. That is the reason why the once famous river systems of Bengal that used to bring fresh silt to the plains and allowed the boats to ply and trade throughout the whole year, are rapidly deteriorating. Instead of bringing happiness they now bring desolation.

Later, when the rains are gone, in some of the smaller waterways, to ply even a tiny "dinghi" is out of the question. On the contrary, these pools become the breeding grounds of mosquitos and other devastating diseases.

The crop that the hill people get out of their *Jhumes* is not worth even a tenth of the damage done by the floods in the plains. But has anybody ever thought of telling them to make proper use of their land, without any damage to their neighbours in the plains?

That the floods are directly caused by indiscriminate *jhuming* is further supported by the fact that in Assam the floods generally occur when the tributaries of the Brahmaputra like Subansiri, Bhareli and Manas from the Himalayas and Diyang, Dima and Kopili from the Naga Hills bring down enormous quantities of rain water.

Human nature is the same the world over. The advanced countries in Europe and America had the same trouble over soil conservation in the hills. They have successfully tackled it whereas we in India still seem to be groping in the dark and have not yet touched the fringe of the problem. Since flood, deterioration of the rivers and water supply all depend directly on the conservation of soil on the hills—

(1) Indiscriminate *jhuming* should be prohibited.

(2) All cultivation on the hills should be on terraces. The terraces should be fairly broad and should have an inner slope so that even after a heavy rain, the water may run towards the centre of the hill.

(3) Contour trenches should be constructed on the hill slopes at intervals to hold up the flowing water and retard its speed. This has proved very effective in the Italian Alps.

(4) Where *Jhuming* must be allowed, the hill people should be made to plant or sow seeds of some fast growing forest trees so that the area can be permanently covered up within a short period and is not exposed to the sun and rain.

(5) The catchment areas of all the big rivers should be made reserved forest.

Interference with the rights and *modus operandi* of others depends on the acceptance of the old Roman legal maxim, *Utere tuo ne alterum noceas*, which means that one must use his own

property in such a way as not to injure another party. This principle is applied in daily life to restrictions between private persons and I see no reason why it should not be applied to safeguard the welfare of the general community when it is jeopardised by the misuse of the rights of the few. So far as protection of forest for conservation of soil and water supply is concerned, the justice of the application of this principle cannot be disputed. Whether Bengal can claim compensation for breach of this principle by the hill people of the neighbouring provinces, I leave it to the legal authorities to decide. But it is obvious that the time has come for concerted action.

It is a matter which goes far beyond the boundaries of any one province in India. Although Irrigation and Forests are now transferred subjects under the direct control of the Provincial Ministers, this is a responsibility of the Central Government of India. There is a Central Irrigation Board in existence and we hear rumours of the formation of a Ganges River Commission and an Eastern Rivers Commission. If it is agreed that the chief cause of flood and deterioration of the rivers of Bengal is the misuse of land in their catchment areas and the best way to tackle the problem is by reafforesting those areas, will the Central Government see that the Bengal Government, particularly its Forest Branch, is duly represented in those Commissions. The provinces may require subsidies from the Central Government for the reafforestation work but one who has seen the effects of flood in Bengal cannot think of a better project on which money for rural development can be more justifiably spent.

THE SWISS NATIONAL EXHIBITION

FOREST SECTION

BY S. A. A. ANVERY, I.F.S.

The Swiss National Exhibition, which is being held nowadays (6th May—29th October) in Zurich, though very big, is perhaps not quite so big as such exhibitions generally are these days. But it is certainly more useful than many other fairs of this type. Switzerland is a rich country and Zurich specially, is one of the wealthiest cities of the world. The engineering and technological

training and equipment of the Swiss people, too, is second to none in the world. These two factors have had full play in making their National Exhibition a really wonderful show. Every activity of the nation has been excellently exhibited in correct proportion to its importance in the national life. Except for a few well-appointed restaurants and coffee houses, there are no shops, and no shopping whatsoever inside the exhibition grounds, and one visits it with the sole purpose of acquainting oneself with the past development, present condition and future needs of every department of the Swiss national life.

As is well known, forests occupy a very important place—if not actually the most important place—in the economy of the national life of this country. The forest section in the exhibition is in proportion to this importance, and illuminating exhibits have been arranged mainly under the following sub-sections:

1. *General.*—Gross figures for area, distribution of forests and species, growing stock, increment and yield, income and expenditure, co-operative sale of produce, export and import, research, etc.
2. *Soils.*—Sections and profiles, comparative data, etc. etc.
3. *Forests.*—Forest types, systems of management, etc.
4. *Protection.*—Against erosion, wind, avalanches, snow, insects, fire, etc. etc.
5. *Exploitation and Export.*—Felling, roads, ropeways, bridges, etc.
6. *Utilisation.*—Timber, fuel, gas, cellulose, chemical products, veneer, paretex, etc. etc.
7. *Wood-working machinery, joinery and handcraft.*
8. *Wood seasoning.*
9. *Wood preservation and fire-proofing of wood.*
10. *Wood technology.*

It is neither possible nor necessary to describe this section or any sub-section of it with any details, but I give below a few of the very striking general features which appealed to me most and which may perhaps be of interest to other forest officers in India:

First about the general layout: Two things are markedly noticeable: First that the look of the section from outside is at once very typically "jungly" as well as extremely attractive and inviting. This is achieved by many ingenious devices, one of which is that pillars in the entrance hall are of unbarked boles of trees, on the front

halves of which huge human figures are artistically carved. Secondly —and this is, in my opinion, very important indeed—the rooms, the exhibits and the "one-way" path for the visitors inside the section are arranged in such a manner that, once you enter it, you are led on from exhibit to exhibit and from sub-section to sub-section till, willy-nilly, you have been through the whole of the section without missing a single exhibit and without ever crossing the same path twice. This device does away with the necessity of guides or demonstrators, and you see the whole show silently and completely without even suddenly colliding with a cross-current of humanity from the opposite direction.

The exhibits are extremely beautiful and cover the whole subject comprehensively. For this purpose illustrations, photos, paintings, film slides, models, samples, graphs, charts, pamphlets and books are used. They refer mostly to Swiss forests and conditions obtained in Switzerland and no purpose can be served by describing them. A few general points, however, may be noted in this connection. All the exhibits have been prepared in such a way that they attract attention more or less forcibly and thus figures and lines, which otherwise are so dry and monotonous, are assimilated unconsciously. I will give an example. The export of wood in 1904 was 1,584 kilos while in 1938 it rose to 1,932 kilos. This fact has been illustrated by a huge map of the world. On it a brown line, representing the export of 1904, goes from Berne, the capital of the Swiss Confederation, to Lisbon in Portugal, while another line of green colour runs from Berne to Moscow in Russia, the distances between Berne-Lisbon and Berne-Moscow being in the same proportion as the export in 1904 and 1938. This is not all. These lines from Berne to Lisbon and Moscow pass through several countries and many cities and all of them have been shown at their proper places with some typical thing such as dress, animals, produce or famous building painted beside them. This ingenious method is by no means the only one of making figures and percentages look less formidable than they otherwise are. Models of trees, ruined and prosperous villages, protection works against erosion and avalanches, bridges, houses, factories, etc., are designed in such a way that they also represent the comparative figures for different years or different treatments. Another method which is even more useful in attracting

attention and leaving a permanent impression in the mind of the observer is the application of the various mechanical devices for illustration. Even in the advanced West such devices have a strong appeal for the public. The forest section is very well provided in this respect too. There are photographic films which continuously operate showing different important forest works. There are other models of protection works against avalanches. You press a button and the avalanche descends and is diverted by the protective works. There are big boards with pictures painted on them, and they automatically revolve so that you can see both the sides. There are models of ropeways, tramways, shoots, etc., which begin working at a touch of the switch button. There are devices which practically show that wood has more calories than most other fuels and is a better medium for cooking or central heating. At another place wood gas is being produced on a small scale and is being utilised. Automatically operated electric lights of different colours illuminate different portions of the map in different patterns at short intervals and thus illustrate terse facts and figures. In fact the whole show has become absorbingly interesting and uncommonly instructive because of these ingenious methods and devices.

Another thing which struck me as particularly useful was the co-operation offered by the allied interests in making the section such a wonderful success. Manufacturers of saw-mill machinery and tools, firms dealing with instruments and apparatus, builders of ropeways, bridges and buildings, gas companies, paper, pulp and rayon factories, stove manufacturers, furniture dealers, timber merchants and private forest owners have all fully co-operated in this common cause and lent exhibits, models, machineries and men, not as a gesture of favour, but realising full well that the publicity their goods will get is worth much more than the expenses of such co-operation. This is a point which we may usefully exploit in India. In this way the expenses are shared by many, and generally big concerns, and the Forest Department is able to put up a big show at a relatively modest outlay.

In the end, I would like to thank Dr. Burger of the Forest Research Institute, Zurich, who was kind enough to take me round the forest section of the exhibition and explain practically everything there.

TIMBER PRICE LIST, SEPTEMBER-OCTOBER 1939
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 36-0-0 to 42-0-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 50-0-0 to 61-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-9-0 to 1-6-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-9-0 to 1-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-6-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-12-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-9-6 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-0-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 53-2-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 42-3-0 to 51-9-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-5-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bombay .	Logs ..	Rs. 48-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Madras .	Logs ..	Rs. 80-0-0 to 100-0-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 31-4-0 to 48-7-0 per ton.

Trade or common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 60-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 37-8-0 to 45-5-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 25-0-0 to 62-8-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-8-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-7-0 to 1-4-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-4-0 to 5-8-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-1-0 to 2-5-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-4-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs	Re. 1-2-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Re. 0-14-0 to 1-2-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-8-0 to 0-9-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-12-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Re. 0-4-0 to 0-6-0 per c.ft.
,, ..	,, ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	Re. 0-11-0 to 1-0-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Re. 0-12-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-13-3 to 2-4-2 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-8-4 to 3-1-4 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 85-0-0 to 137-8-0 per ton.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

EXTRACTS

FORESTRY AT OXFORD

BY R. S. TROUP

An amended Statute concerning the School of Forestry, with regulations, was published in the *Oxford University Gazette* of April 26th. The Statute was approved by Congregation on May 2nd and the regulations come into force with it. A comparison of the new Statute and regulations with those hitherto in force will reveal a considerable raising of the standard of knowledge required by candidates for admission to the Final Examination as well as a widening of the scope of that examination. Whereas hitherto the normal avenue to the Final Examination has been a special Preliminary Examination of a comparatively simple nature, in future "No Candidate will be admitted to the Examination unless *either* he has obtained honours either in Honour Moderations in Natural Science or in

a Final Honour School, *or* is a Senior Student." Candidates must produce evidence of having passed approved examinations in Botany, Geology, Physics and Chemistry, if these subjects are not included among those already passed in Honour Moderations or in a Final Honour School. Thus the prior qualifications required of candidates for the School of Forestry will be considerably higher in future than they have been in the past, and the School becomes, in part at least, a post-graduate one The changes which have taken place from time to time in the curriculum of the School of Forestry have been a natural outcome of the development of forestry in the Empire and the requirements of the forest services. A short account of the past history of forestry at Oxford, in its relation to these services, may therefore be of interest.

Owing to its long-range character, forestry is particularly suitable for State enterprise, and there are few countries in which the State does not own forests and employ a staff of trained forest officers to manage them. Nevertheless, in the great majority of European countries State forests occupy less than half the total forest area and private forestry is a matter of great importance. Where State control is not in force the management of private forests often leaves much to be desired and hence, in many countries, control is enforced with a greater or lesser degree of strictness. In view of the importance of forestry to the welfare of a country, the obligations of the State in regard to forest education are generally recognised. In some countries, therefore, training institutions are maintained by the State, while in others forestry forms a branch of university study assisted by the State. Both methods have their advantages and disadvantages.

Although in many European countries scientific forestry has been practised and developed for centuries, in the British Empire its importance began to be recognised only after the middle of the last century, when steps were taken in India to form a forest service of qualified officers. In the absence of any recognised British school, these officers were trained for a number of years at the National School of Forestry at Nancy. In 1885 a properly equipped forestry branch was established at the Royal Indian Engineering College, Cooper's Hill, a college maintained by the Government of India to provide officers for its own services. Twenty years later, on the

closure of Cooper's Hill, its forestry branch was transferred to Oxford and the Oxford School of Forestry came into being in 1905. The school was established primarily for the purpose of training probationers for the Indian Forest Service and for a number of years it was maintained by subsidies from the India Office. Up to 1914 the great majority of its students joined the Indian Service, although a few obtained appointments in the Colonies and elsewhere.

After the War recruitment in Great Britain for the Indian Forest Service continued for some years and then ceased. Meanwhile, owing to developments in the Colonies, in Britain and elsewhere, the demand for qualified forest officers was maintained and has continued ever since, subject to fluctuations due to economic causes. The appointments secured by the 324 men who passed out of the School of Forestry between 1920 and 1938 may be classified as follows:

Indian Forest Service (none after 1927) ...	114
Colonial Forest Service	76
Burma Forest Service (none before 1930) ...	24
Dominions Forest Services	24
Forestry Commission	12
Other Government Forest Services	8
Private employment (forestry and similar work) ...	27
Employment other than forestry	39
	324

An important event in the history of forestry at Oxford was the establishment in 1924 of the Imperial Forestry Institute, whose main functions are: (1) advanced instruction, (2) research and (3) the service of information. The third function has been taken over in part by the Imperial Forestry Bureau recently established at Oxford. The Institute constitutes no charge on the University, but is supported by contributions from the Forestry Commission, the Colonies and certain other parts of the Empire. At the outset the Professor of Forestry was appointed its Director, a post which he held for eleven years. As the work of the Institute increased, it was felt that the duties of the Director should be separated from those of the Professor, although the latter should remain in nominal charge of the whole Department. As an experimental measure, therefore, a

separate Director was appointed in 1936, but the system of dual control proved unsatisfactory, and in 1938 it was decided to abolish the post of Director and to unite the School of Forestry and the Institute more closely than before as a self-contained Department under the immediate charge of the Professor. This arrangement came into force on August 1st, 1939. During the fifteen years of its independent existence, from 1924 to 1939, the total number of students attending the Institute was 351, giving an average of about 23 a year. If these numbers are maintained in future the post-graduate work in the reconstituted Department of Forestry will be considerable.

Up to 1919 the course of instruction at the School of Forestry extended normally to two years, and led to a Diploma in Forestry. A Pass Degree was instituted in 1919, and not long afterwards a post-Graduate Diploma was substituted for the one previously in force. This arrangement is still in operation. The method of recruitment for the Forest Services has had some influence on the course of instruction provided. For some years probationers for the Indian Forest Service were selected from among candidates possessing a Degree with Honours in Natural Science, and were then given a two-year course of training in forestry with the aid of scholarships. Hitherto recruits for the Colonial Forest Service and the British Forestry Commission have been selected from among candidates already possessing a Degree in Forestry. This method has one serious disadvantage, namely, that many promising men are deterred from embarking on a training in a highly specialised subject in which the number of posts available is very limited; this has undoubtedly restricted the field of selection and lowered the general average standard of the recruits.

In 1938 an entirely new method of recruitment for the Colonial Forest Service was announced, and this has been mainly responsible for the present change in the Forestry Statute. Under this scheme, while the door will not be entirely closed to graduates in forestry, at least a portion of the recruits will be selected from among candidates who have graduated with honours in natural science or in other subjects. Selected candidates, with the aid of scholarships, will then undergo a course of training in forestry extending normally to two years, this period being divided in the middle by an interval of

practical work (the "apprentice tour") in the Colony to which the scholar is to be appointed. This method of selection should secure recruits of a higher average calibre than the method hitherto in force. The interruption of studies occasioned by the "apprentice tour" may produce difficulties from the teaching point of view, but the system is worth a trial; it will in no way affect students other than those selected for the Colonial Forest Service, who will follow the two-year course of instruction without interruption.

So far as the Final School of Forestry is concerned, the new Statute, as we have seen, involves a marked raising of the standard. Although it will still rank as a Pass School, the avenue to it will be through Honours in one form or another, and the graduates turned out will have higher academic qualifications than most of their predecessors. Let it not be forgotten, however, that academic qualifications alone will not make the ideal forest officer. Of equal, if not greater, importance are such qualities as physical energy, self-reliance, administrative ability and capacity for handling subordinates and getting work done.—*The Oxford Magazine*, 1st June 1939.

RURAL RECONSTRUCTION

Of all the problems that India presents to-day, there are probably none so pressing, none so urgent as the problems of rural reconstruction and rural education. Rabindranath Tagore, who is better known as a poet, philospher, dramatist and novelist, expresses his ideas about our villages in the following statements:

"Villages are like women. In their keeping is the cradle of the race. They are nearer to nature than towns and are therefore in closer touch with the fountain of life. They have the atmosphere which possesses the power of healing. It is the function of the village, like that of women, to provide people with their elemental needs, with food and joy."

"There was a time when our villages were in intimate contact with the manifold culture of this land. Towns were administrative centres serving certain special purposes, mostly of an official and

professional character, while for the complete purposes of the people's life, the villages were cherished and served by all the capable persons of the land with the most of their means and the best that their minds produced. But to-day, for various reasons, villages are totally neglected. They are fast degenerating into serfdom, compelled to offer to the ungrateful towns cheerless and unintelligent labour for work carried on in an unhealthy and impoverished environment."

Problems of Rural India.—The problem of rural reconstruction in India is not the same as was the problem of reconstructing the devastated areas of France and Belgium after the Great War. Their problem was only that of reconstructing the brick walls of houses destroyed by cannon shells and bombs. The problem of the Indian villages is not so much to rebuild the tumbled down houses and mud huts as it is to revive and develop the village life as a whole, in all its aspects, socially, culturally, economically and from the point of view of sanitation and health.

More than three-fourths of the population of India depend for their maintenance solely upon agriculture and consequently live in villages, but, unfortunately, these villages, which form the real India, and the bulk of the population, have been totally neglected. The problem of rural reconstruction is manifold. It is economic, social, religious, educational and of health and sanitation. In order that it may be adequately and effectively attacked, all forces are required really and truly to reconstruct the whole of the country. All the sources that modern science has to offer us will have to be utilised in this task.

Civilisation in every country has been changing but it has never changed so rapidly as during the present age. Our country cannot live on its past glory. That civilisation was good only so far as those days were concerned. In order to suit the conditions of modern life and the present day civilisation, we cannot go back to the past and seek shelter in her glories. We have to free ourselves from the fetters of the old civilisation, keeping only what is best in it and building upon it with the materials that modern science has to offer us. Many of these modern ideas have to be imported from the West, but they will have to be modified to suit our conditions.

The work of rural reconstruction, even of reconstructing the whole country, is being carried on to some extent even in some of the European countries. But probably no other country in the world presents so many problems as does India. It would not be altogether fair to criticise the Government for its neglect in attacking this problem, although the Government cannot be held blameless. The village industries so necessary for the prosperity of the vast population of rural India, and which for centuries have been the mainstay of the prosperity of the country, have all been destroyed by foreign industries. The agricultural industry, which is the main occupation of about 75 per cent. of the population, has also been allowed to decay. The land-tenure system, the illiteracy of the peasants, the lack of irrigation and many other causes do not permit the land to flourish. The farmers can hardly make a bare living and during years of drought they are driven to extreme poverty and starvation.

The Country of Extremes.—India presents extremes probably greater than those of any other country. Geographically, it shows extremes in climate, from the coldest to the hottest; from the most fertile soil to the most barren and arid tracts, from the highest rainfall to the lowest; from the most healthy spots to the worst forms of epidemic-ridden regions. Economically, there are the very rich people on the one hand, living in magnificent palaces, in ease and luxury, and the starving millions on the other, living in dirty mud houses, stricken with various kinds of diseases.

Intellectually and spiritually, there are to be found in India some of the world's famous poets, philosphers, artists and scientists, as well as saints and seers who claimed to have realised the Divine Truth, while on the other hand we find thousands steeped in ignorance and superstition. As to physical fitness also, India can boast of some of the finest specimens of strong, sturdy and healthy men and women, while at the same time showing some of the poorest specimens of all humanity. It is with the millions of semi-starved people, sunk in poverty and despair, living in the open country and yet in the most insanitary conditions, and suffering from all kinds of diseases, that we are concerned here. In short, the rural problems may be summarised as follows:

Cities like Bombay and Calcutta do not represent India. It is the Indian village which, with all its worst sanitation, ignorance, distress and superstitions, shows the true picture of real India. It is in the cottages of these 700,000 villages that the heart of this nation lies; unless, therefore, this heart gets proper nourishment, the body, *i.e.*, the nation, cannot hope to prosper any more.

An Indian agriculturist is the foundation on which the whole economic prosperity of India rests and upon which the structure of its social and political future must be built. But to-day he is completely sunk in the darkness of ignorance and is suffering very much from distress and poverty. He is completely in the clutches of the money-lenders and does not get sufficient food, clothing and proper housing.

In connection with the solution of these problems, the great poet Rabindranath Tagore advises the young generation through his famous poetry as follows:

"Leave this chanting and singing and telling of beads! Whom dost thou worship in this lonely dark corner of a temple with doors all shut?

Open thine eyes and see that thy God is not before thee!

He is there where the tiller is tilling the hard ground, and where the pathmaker is breaking stone, He is there with them in sun and in shower.

And his garment is covered with dust.

Put off thy holy mantle and even like him come down on the dusty soil!

Come out of thy meditations and leave aside thy flowers and incense!

What harm is there if thy clothes become tattered and stained?

Meet him and stand by him in toil and in sweat of thy brow."

Thus it is seen that all our activities of rural reconstruction must centre round the villager and his village. In trying to solve these problems the entire social and economic order have to be changed, and all the forces available will have to be employed. The Government has to be urged to take the matter in hand and spend more money on education, public health and agricultural improvement than it has done hitherto. In the very name of human

justice and in consideration of the worth of human life, the Government ought to come forward and contribute its share in removing the poverty of the people and freeing them from disease.

Propaganda needs to be conducted on platform as well as in the Press to stimulate the people. The masses need to be made to understand India's position in comparison with that of other countries. They also have to realise their own responsibility in the performance of the great task of reconstruction. In doing this the differences between the various communities, castes, creeds and races will need to be carefully and cautiously adjusted. The people should be made to forget these differences for the sake of the common good, and to realise that anything that they do to help each other will react not only to their own good but to that of their Motherland also.

Unless the people are willing to free themselves from evil customs and superstitions, to break the bonds of caste and themselves give freedom to the millions who are called "untouchables," the country cannot expect to be free from the outside yoke. So, then, to attain true freedom, progress has to come from within. Many years ago Tagore expressed this, and his words stand as true to-day as they did then:

> "Whenever the people of one single village will have learned effectively to combine for the promotion of health, education, employment and enjoyment of life of each and all within that village, they will have lighted a torch in the path of Swaraj for the whole of India. Thereafter, it would not be difficult to light one torch from another, and so Swaraj will advance of itself, not only by the path traversed by the mechanical revolution of the *charkha* or such like, but along the route of multi-sided development illumined by its spirit of self-reliance."

—*M. A. Kolkhede*, B.Sc. (Research Scholar, Imperial Dairy Institute, Bangalore), in *The Allahabad Farmer*, Vol. XIII. No. 3, May 1939.

FOREST INDUSTRIES

The holding of a Forest Products Exhibition under the auspices of the Calcutta Commercial Museum has been a very timely move on the part of the Museum authorities. The economic significance of forests has not been sufficiently appreciated by the lay public while the Government have only recently been awakened to the necessity of evolving a correct forest policy for India. The total area under forests in this country is about 89 million acres representing about one-seventh of the total area of British India. There has, however, been a steady denudation of forests on account of the thoughtless manner in which they have been, and are still to a great extent being, used by the people of the country and on account of the pressure on agriculture which, since the decay of Indian industries, has greatly increased rather than diminished. This has been particularly the case with the Gangetic Plain Botanical Province, regarding which Mr. Calder observes in the *Field Sciences of India*: "It is agriculturally the richest part of India and is now to a very great extent given over to cultivation. With the exception of the Sunderban part, the flora, therefore, is not now what came from or what it would revert to if the hand of man were removed. There are records of its being covered at one time by vast forests of sal which have now all but disappeared except on the slopes and at the base of its mountain boundaries." Yet a sane forest policy is necessary for the preservation of agriculture itself and the agriculturist. Forests provide the cultivator with fodder for his livestock, act as a second line of defence during a famine and are necessary as a protection for soils liable to erosion. Yet even the government departments which are supposed to be manned by highly-paid experts have never succeeded in looking at the problem in its true perspective. Only about three years ago, a member of the Indian Forest Service thus spoke on the cross-purposes at which the different departments of the government often move: "The revenue department is anxious to collect its revenue, the forest department to grow trees, the agricultural department to cultivate better paying crops, the veterinary department to rear more stock, the local landowner to keep a stud-bull, the irrigation department to find more

canal water, the public health authorities to improve the drinking water." Thus the land under forests is subjected to competing demands, and ultimately the department that can, perhaps, talk the loudest wins. In any case, the forests suffer.

India, being principally an agricultural country, will naturally try to relate her forest policy to the needs of agriculture. But forests are also an important industrial and commercial asset and the Exhibition at the Commercial Museum is intended to emphasise this aspect of the problem. It is well-known that forests yield many kinds of industrial products which can be used on a commercial scale. The making of paper pulp from bamboos, the extraction of turpentine, of oils, gums and resins—these are some of the well-known varieties of forest industries which, however, yet await fuller exploitation. For instance, in our country, the use of well-seasoned timber for interior decoration is yet to be developed. A recent report of the Dehra Dun Institute pointed out the commercial possibilities of plywood and expressed the opinion that the starting of a plywood mill in Calcutta was bound to be a profitable proposition. Again, wood preservatives like the *Ascu*, which can be a very cheap substitute for creosote crude oil treatment and is already being extensively used over certain railways in India on account of its cheapness, offer a profitable field of research. In fact, the far-reaching effects of research can hardly admit of any precise determination. Even artificial silk can be produced with the help of bamboo pulp. In short, a proper exploitation of our vast forest resources can add greatly to the wealth of India. What is required is an appreciation of the proper value of this gift of nature. Fortunately, science has already provided man with a knowledge of the true functions of forests and if the results of science are applied to the service of India, we can look forward with confidence to the creation of the new sources of wealth for the people of the country. Exhibitions go far towards popularising the knowledge that science provides us with and we congratulate our friend, Srijut Jnananjan Neogi, on having arranged this exhibition and popular lectures in connection with the same. Let us hope that the magic touch of capital will not fail to utilise this knowledge to proper advantage.—*The Hindusthan Standard, dated the 30th June 1939.*

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons)					
	MONTH OF AUGUST			5 MONTHS, 1ST APRIL TO 31ST AUGUST.		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	23	18	..	384	636	30
French Indo-China	141	118	348	831	2,445	2,362
Burma ..	11,376	11,323	14,636	65,943	62,471	61,002
Java ..	1,121	283	186	2,310	1,250	1,542
Other countries ..	25	..	..	517	10	..
Total ..	12,686	11,742	15,170	69,985	66,812	64,936
Other than Teak—						
Softwoods ..	1,749	1,034	840	8,588	6,869	5,788
Matchwoods ..	566	658	571	4,833	4,435	4,483
Unspecified (value)						
Firewood ..	49	60	68	289	286	240
Sandalwood ..	..	..	21	55	46	57
Total ..	2,364	1,752	1,500	13,765	11,636	10,568
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	..	..	..	..	..	..
Sleepers of wood ..	160	..	160	251	133	598
Plywood (tons) ..	515	241	489	2,753	2,286	3,303
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	675	241	649	3,004	2,419	3,901
Total Volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	9,006	22,926	18,603	95,348	139,620	71,870

Seaborne Trade and Navigation of British India for August 1939 :

IMPORTS.

ARTICLES	VALUE (Rupees)					
	MONTH OF AUGUST			5 MONTHS, 1ST APRIL TO 31ST AUGUST		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	4,248	1,603	..	45,498	81,554	3,336
French Indo-China	14,953	17,578	34,387	89,536	2,98,011	2,53,667
Burma ..	14,50,219	15,31,774	18,33,725	81,75,952	83,66,735	76,58,765
Java ..	1,36,732	32,558	19,195	2,87,539	1,37,030	1,59,629
Other countries ..	2,711	..	..	56,196	806	..
Total ..	16,08,863	15,83,513	18,87,307	86,54,721	88,84,136	80,75,397
Other than Teak—						
Softwoods ..	1,34,140	73,382	55,911	6,41,955	5,17,014	3,80,975
Matchwoods ..	37,984	47,236	37,588	2,90,347	3,00,279	3,17,337
Unspecified (value)						
Firewood ..	735	904	1,020	4,332	4,276	3,610
Sandalwood ..	..	..	3,880	18,383	13,329	13,738
Total ..	1,72,859	1,21,522	98,399	9,55,017	8,34,898	7,15,660
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	2,14,533	1,36,717	1,92,895	9,95,947	7,15,993	6,79,112
Sleepers of wood ..	24,934	90	30,015	38,572	19,276	84,335
Plywood (tons) ..	1,06,299	58,008	88,814	5,89,800	5,02,139	6,14,098
Other manufactures of wood (value) ..	1,62,257	1,31,113	1,28,674	8,00,537	6,97,952	6,71,974
Total ..	5,08,023	3,25,928	4,40,398	24,24,856	19,35,360	28,49,519
Total value of Wood and Timber ..	21,66,392	21,09,509	23,97,088	1,19,48,489	1,23,04,591	1,12,89,910
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	62,088	2,14,784	1,24,177	7,31,798	13,40,421	5,49,486

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF AUGUST			5 MONTHS, 1ST APRIL TO 31ST AUGUST		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	35	2	..	100	2	20
,, Germany ..	..	..	..	..	1	..
,, Iraq ..	15	32	227	100	140	268
,, Ceylon ..	1	..	..	1	1	30
,, Union of South Africa ..	..	..	..	..	..	..
,, Portuguese East Africa ..	..	..	..	..	..	..
,, United States of America ..	..	..	..	..	..	..
,, Other countries	56	262	78	286	820	835
Total ..	107	296	305	487	964	1,153
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	3	..	..
Unspecified (value)						
Firewood ..	..	..	..	115	..	..
Total ..	..	..	..	118	..	..
Sandalwood—						
To United Kingdom	4	..	..	6	11	..
,, Japan ..	7	18	..	13	22	51
,, United States of America ..	51	..	10	218	135	46
,, Other countries	22	12	12	194	53	112
Total ..	84	30	22	431	221	209
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	..	..	..
Total volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber	No data			No data		

EXPORTS

ARTICLES	VALUE (RUPEES)					
	MONTH OF AUGUST.			5 MONTHS, 1ST APRIL TO 31ST AUGUST		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	4,600	375	..	14,438	375	2,600
„ Germany ..	..	..	..	..	150	..
„ Iraq ..	4,808	7,647	7,004	22,539	42,223	16,431
„ Ceylon ..	100	..	..	100	154	2,145
„ Union of South Africa ..	..	..	..	..	..	..
„ Portuguese East Africa ..	..	..	..	..	..	..
„ United States of America ..	..	..	..	..	..	..
„ Other countries	17,530	91,181	17,718	78,249	2,77,103	1,61,059
Total ..	27,038	99,203	24,722	1,15,326	3,20,005	1,82,235
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	..	..	..	840	72	..
Unspecified (value) Firewood ..	..	..	..	1,027	..	..
Total ..	..	..	..	1,867	72	..
Sandalwood—						
To United Kingdom	4,000	..	..	6,600	12,375	..
„ Japan ..	6,800	19,800	..	13,400	23,773	54,025
„ United States of America ..	50,800	..	11,000	2,16,840	1,42,000	49,110
„ Other countries	20,145	10,662	10,250	1,96,538	55,239	1,05,792
Total ..	81,745	30,462	21,250	4,33,378	2,33,387	2,08,927
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	25,229	38,481	28,655	1,04,986	1,72,143	1,24,992
Total value of Wood and Timber ..	1,57,089	1,82,686	95,107	14,28,549	8,37,402	6,41,921
Other Products of Wood and Timber ..	No Data			No Data		

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INDIAN FORESTER

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ARTIFICIAL REGENERATION OF WENDLANDIA EXSERTA D. C.

BY N. P. MOHAN, I.F.S.

Summary.—Seed should be collected towards the end of May or beginning of June and sown in pots or boxes, lightly covered with soil which should be disturbed on the seventh day. To be kept shaded. Watering by can with very fine rose. Surface should never be permitted to dry up. Germination after eight days. Pricking out in pots when the seedlings are one to two inches high. Planting in the following year.

Introduction.—Parker in his "Forest Flora for the Punjab with Hazara and Delhi" says that *Wendlandia exserta* "has been suggested for afforestation work but it appears to be difficult to grow from seed. I have tried it several times without success. The plant is ornamental when in flower and would be worth growing in gardens." This was written as far back as 1924. The Divisional Forest Officer, Kangra Forest Division, inquired from the Research Division, in 1933, the best way of growing the species from seed but could get no help. The Central Silviculturist, too, had no information. The Research Division sowed the seed (or what it thought was seed) in patches at Nurpur in 1934 but fared no better than Mr. Parker. Subsequent spasmodic efforts produced no better results. The species was taken for intensive work in 1938 at the Nurpur Research Station (situated in Kangra Division at an elevation of 1,900 feet; average rainfall 57 inches of which about 45 inches fall from June to September). Repeated successes in 1938 and also in 1939 are an excuse for this article.

The tree is very common in Kangra Division and ascends up to nearly 4,000 feet but is more frequent between 1,000 feet to 3,000

A

feet. It is a pronounced colonist of newly exposed soils (*e.g.*, landslips and steep slopes). On landslips on clay in Kangra it comes up in groups wherever the falling debris has a chance of resting or remaining stable for some time. Slips occur during the rains, when the soil remains fairly soaked with moisture: the atmosphere is hot and moist with occasional intervals of brilliant sunshine; the weather is muggy and clammy. It is under such circumstances that germination takes place in Nature and the basis of all trials has been to create as close an imitation of natural surroundings as possible. These conditions are:

(*i*) The site of trials is free from circulation of air; particularly hot and dry.

(*ii*) Soil is kept constantly moist.

(*iii*) Seed-bed is exposed to sunshine at some time.

(*iv*) Little or no covering of the seed as in the natural habitat of the species mineral soil is being constantly exposed by erosion.

(*v*) Occasional disturbance of the soil for the same reason as in (*iv*).

(*vi*) Soil medium to be such that there will be no weed growth *of any kind.*

No.(*i*) was ensured by making trials in a small compound (measuring 22 feet by 14 feet) with walls seven feet high. This small area was a complete imitation of natural surroundings. Other items were not difficult to control.

The tree flowers from March to May and at Nurpur the best season for collecting seed proved to be end of May and beginning of June. Too early and too late collections contain a very small proportion of fertile seed. Collections made late in the season only result in the collection of capsules from which the seed has already escaped. Seed can be collected by shaking the capsule—bearing branches (ripe capsules are yellowish brown) after stretching a cloth beneath it when no wind is blowing. Seed is minute, not larger than a pin point. Duthie in his flora of the Upper Gangetic Plain says that it

is "obscurely" winged, but it is not at all winged. It is yellowish or dark brown, rugose and oily (if crushed against a piece of paper, it will produce a grease spot). Tests so far show that it retains its viability for at least 14 months. No special precautions were taken in storage. It was merely kept in an ordinary envelope. Profuse germination was obtained principally under two methods, *viz.* (*i*) Rise of water by capillarity and (ii) watering by can with very fine rose.

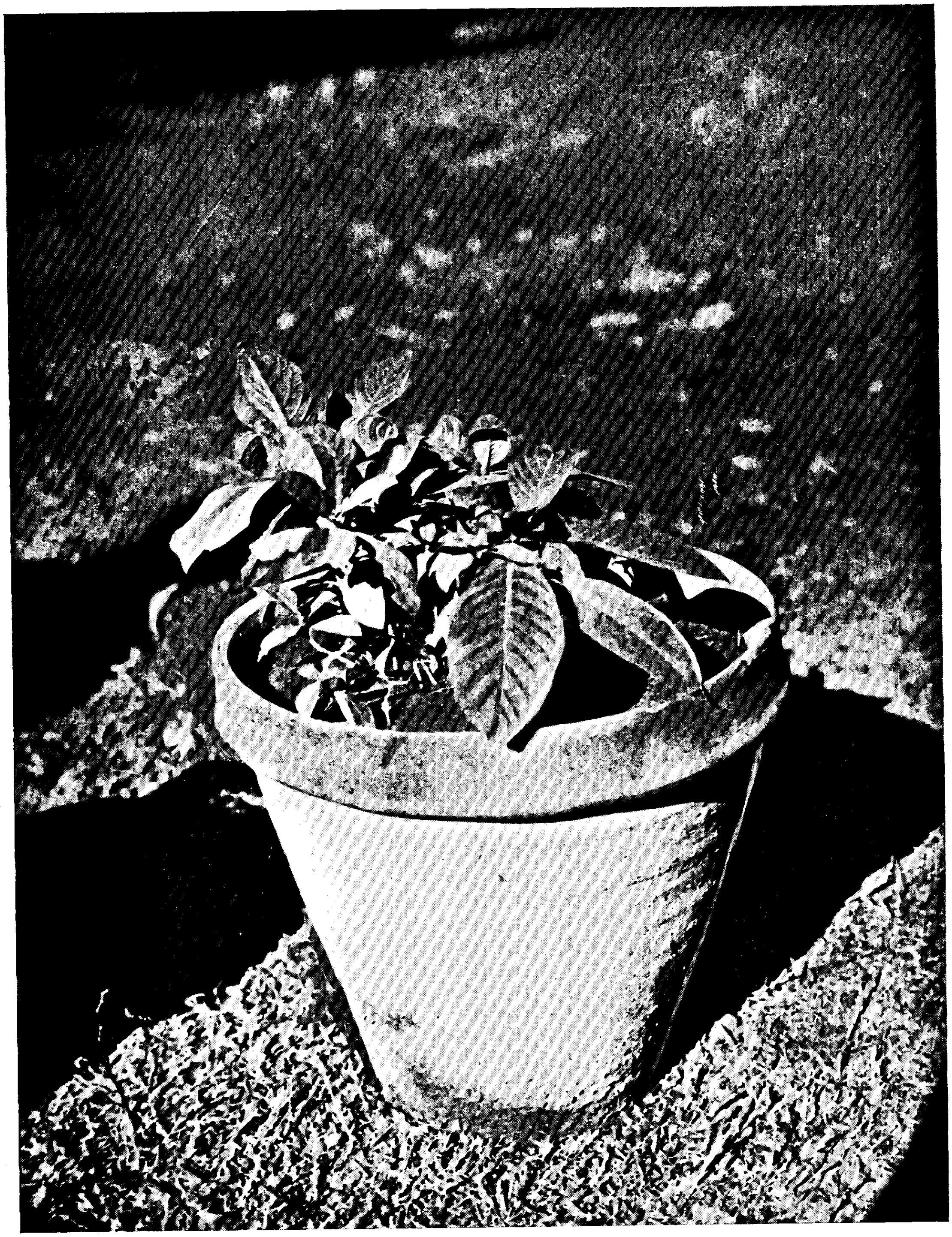
(*i*) *Rise of water by capillarity.*—Sowings were done in bottomless pots (five by five inches) placed in flat, two-inch deep, earthen dishes (*kunalies*) which were kept filled with water to allow the water to rise in the pots. Pots contained two sets of soil media *viz.* (*i*) clayey loam obtained from newly exposed *Wendlandia exserta* locality and (*ii*) mixture of clayey loam, leaf-mould and sand in equal parts by volume (called "light soil" in this article). Seed was sprinkled over thoroughly soaked soil in the pots. In one case seed was lightly covered and in the other not covered at all. Care was taken to see that the surface of the soil was always kept moist, watering being done carefully (so as not to wash the seed to the outside), even at the top if the weather became too dry and hot. Pots were exposed to morning sunshine for two hours up to 8 a.m. and were kept under complete shade (of mats put up at about four feet from ground level) during the rest of the day. Shades were not removed even at night. Different soil media made no appreciable difference in germination though light soil proved slightly better. Both the soils were, however, remarkably free from weeds. Germination commenced after eight or nine days and was completed within a week. Profuse germination was obtained from uncovered and fairly good from covered seed. It may again be emphasised that the surface of the soil must remain constantly moist. The greatest danger is from its drying up.

(*ii*) *Watering by can with very fine rose.*—By "very fine rose" is meant a really very fine rose and the greatest care is to be exercised in its selection. Numerous trials were carried out under this mode of watering as this naturally would be the method to be commonly adopted by territorial divisions in their nursery practice. For the same reason "light soil" was used as the soil medium in all cases. Watering was done with can with very fine rose and at no time was

the surface permitted to dry up. The following table summarises the results:

Containers	Shaded or unshaded	Particulars	Commencement of germination after days	Duration of germination days	Germination results
I. Boxes (ordinary packing cases size 2′ × 1″ × 8″ depth.)	Shaded..	(*i*) Seed uncovered	8	7	Fairly good.
		(*ii*) Seed slightly covered ..	8	7	Profuse.
		(*iii*) Slightly covered but soil disturbed on the seventh day after sowing ..	8	7	Very profuse.
II (*a*). Pots (size 6″ × 6″) with bottom.	Shaded..	(*i*) Seed uncovered	8	7	Fairly good.
		(*ii*) Seed slightly covered ..	8	7	Profuse.
		(*iii*) Slightly covered but soil disturbed on the seventh day after sowing ..	8	7	Very profuse.
II (*b*). Pots (size 6″ × 6″) with bottom.	Unshaded *i.e.* in the open.	(*i*) Seed uncovered	No germination.		..
		(*ii*) Seed slightly covered ..	16	7	Fair.
		(*iii*) Slightly covered but soil disturbed on the seventh day after sowing..	9	14	Profuse.

No unshaded set of boxes was maintained as other trials had not warranted much of success. Comparisons are possible between I and I (*a*) and II (*a*) and II (*b*) above. Shaded boxes or pots, seed slightly covered but soil disturbed on the seventh day after sowings, have



Wendlandia exserta

Pricked out seedlings 11 months old. Nurpur Research Station.

Photo: N. P. Mohan.

given the best results. Height growth under shaded pots has been better than under unshaded. Lack of shade delays germination, prolongs the duration and the results are not so satisfactory; and if in addition the seed is not covered, no germination results. The latter explains the failure of the 1934 patch sowings when no shade was provided to the patches, soil was not kept moist and no measures were adopted to prevent the seed from being washed away.

Seed has been sown this year on ridged beds (*i.e.*, an ordinary nursery bed provided with small ridges, tops of which only are sown) shaded by a corrugated iron sheet about a foot high from the ground level. Water flows only between the ridges. Germination has been profuse.

On germination, seedlings are minute and appear from a distance like a green, fluffy mass. On close observation, tiny leaves can be made out. The following table shows the development:

Age	Shoot	Root	Remarks
1 day	Very minute.	0·025 inch	With cotyledonary leaves.
3 days	Ditto.	0·05 ,,	Ditto
15 days	0·05 inch	0·25 ,,	New leaves appear.
One month	0·1 ,,	0·7 ,,	
$1\frac{1}{2}$ months	0·3 ,,	2·75 inches	
$3\frac{1}{2}$ months	3·5 inches	6·0 ,,	

Root grows more rapidly in infancy than the shoot. Active growth begins after about six or seven weeks. In "light soil" under shade six-inch height is obtained after $5\frac{1}{2}$ months but in pure clayey loam (taken from *Wendlandia* locality) it is only $1\frac{1}{2}$ inches in the same time.

Seedlings must be pricked out in pots very early otherwise the mortality is high. Pricking out is done when the plants are about one to two inches high. They will attain about six to eight inches height by December, *i.e.*, in about six months (see illustration—a pricked out seedling in pot).

Transplants have been put out in the forest during the 1939 rains (*i.e.*, when just over one year old) and they are now quite

well established. They were about eight to twelve inches high when put out in the forest.

The entire work was carried out almost unaided by Forester Agia Ram (in charge, Nurpur Research Station) who not only maintained but enhanced his reputation of being an extremely accurate and careful worker.

COUNTER-EROSION WORKS IN SAUJ KAS

By R. S. Chopra, P.F.S.

The condition of the Punjab foothills is too well known to be described. One of the sore spots is the Salt Range in the West Punjab. This low range of hills running east and west across the Jhelum District in a double series of parallel ridges presents a terrible picture of desolation. The hills are almost devoid of vegetation a few sickly bushes and stunted *phulai* (*Acacia modesta*) trees only emphasise the general barrenness. Their present condition is the result of persistent misuse of natural vegetation in the past by over-grazing and clearance of woody growth for domestic use coupled with land hunger for cultivation. Consequently the hills give rise to many a violent torrent which, during summer floods, transport and deposit large quantities of silt and debris on the agricultural lands, causing considerable financial loss and economic distress to the inhabitants at the foot of the hills. Sauj *Kas* in Chakwal Tehsil of Jhelum District is one of these destructive torrents where counter-erosion works have recently been started and which are described in this note.

Catchment area and behaviour of the Kas.—Parts of Bakshiwala Reserve Forest and of Surlal unclassed forest, about 3,000 acres in area, form the top of the catchment area of the *Kas*, below which are village *shamlats* and private grazing grounds of about the same extent, all fretted with gullies and ravines. Much of the area is sheet rock composed of strata of very soft sandstone or a hard nodular red clay or marl. The upper surface is weathering rapidly and much of the surface soil has been washed away. The sandstone area still supports a sparse crop of degraded *phulai* and feeble tufts

of grasses in pockets of good soil; but the red clays are conspicuously bare and severely ravined, largely accelerating the surface run-off. After passing through this badly cut-up country the *Kas* fans out into the plateau land and, after being joined by other torrents, assumes formidable proportions; so much so that near Murid village about 10 miles down from the source its bed is nearly a one-mile sea of sand.

Owing to scanty rainfall in the Salt Range the *Kas* remains dry for the greater part of the year, but in the rainy season (July—September) it is intermittently in flood. A huge sheet of silt-charged water several feet deep goes down, causing damage all along its course through scouring and deposition of sand. The damage has been particularly severe in the neighbourhood of Bhawan and Murid villages; and the existence of Murid village itself is now threatened through under-cutting of the high bank on which it is situated. The control of this destructive process has therefore been engaging attention for some time past.

Control measures proposed.—To begin with several ambitious and expensive engineering projects were discussed for the protection of Murid village and for the utilisation of flood water by impounding the main current at some suitable place. But on mature consideration these schemes were abandoned as financial gambles owing to the violent and short-lived nature of the torrent. Eventually the Forest Department was called upon to suggest suitable reclamation measures to alleviate the sufferings of the people. A preliminary survey carried out by officers of the Department showed that control work was of little value unless based on proper understanding of the factors and processes involved. No permanent relief could be brought to Murid village unless erosion was controlled at the very source and the catchment area of the *Kas* was reconditioned to afford efficient check against run-off and soil transportation. Accordingly a scheme for the area, estimated to cost about Rs. 20,000, was prepared by Dr. R. M. Gorrie. Briefly the scheme prescribed:

1. Reforestation at the head in Bakshiwala and Surla forests over selected parts where there was a reasonable chance for establishing plant cover.

2. Ravine control by gully plugging in the upper reaches of the main *Kas* and its branches by making a series of small stone bunds (dams).
3. Extension of cultivation in the lower parts of Surla Forest by leasing suitable sites to right-holders on easy terms on their agreeing to maintain a set standard of terracing and *watt-bandi*, combined with upkeep of *bunds*.
4. Development of waste land through terracing, grazing control and extension of improved cultivation. Encouragement of a high standard of cultivation and *watt-bandi* by assistance, reward, or remission of land revenue.
5. *Kas* training and reclamation by planting so as to stabilise the banks and confine the torrent within reasonable limits.
6. Education of villagers in run-off control and reclamation works by means of demonstration areas, etc.

Works in progress.—The scheme was financed by the Government grant for rural reconstruction and work was started in 1937 under the control of Khan Sahib Malik Allah Yar Khan, Deputy Conservator of Forests, working in co-operation with the Deputy Commissioner, Jhelum. As a preliminary measure the upper part of the catchment area was closed to grazing through the co-operation of the villagers in order to give the natural vegetation a chance to recover. Afforestation offered little scope as the steep and deeply eroded slopes in their present state were incapable of supporting any tree growth and it needed years of protective regime to restore even partially the productive capacity of the soil. This item of work was therefore restricted to a few suitable flats and valley bottoms where mesquite (*Prosopis glandulosa*) was sown along interrupted trenches with some success and it is intended to carry on the work with a special form of *Prosopis juliflora* (known as *Arid*) which on research has been found to be well adapted to impoverished and shallow stony soils. The present efforts have been mainly concentrated on Items 2 and 5 of the scheme, *viz.*, gully plugging and stream training. Good progress has been made with gully plugging and, in the course of the last two years two sections of the *Kas* have been treated, starting at the head and working downwards. Over two hundred rough stone *bunds* have been constructed in the *Kas*

bed at suitable places where the maximum damming effect could be achieved consistent with the safety of the *bunds* during floods. The success of the *bunds* has been most striking in retaining run-off and holding large quantities of silt and water. Behind the *bunds* good silted flats have been formed which are expected to absorb a lot of flood water and thus reduce the intensity of floods. At the same time they provide suitable sites for tree planting and growing fodder for the villagers.

A beginning with stream training work has been made at Murid in order to afford some direct protection against the undercutting of the bank. A few spurs running obliquely to the *Kas* bed have been put up and they have given a fair measure of success in deflecting the main force of the torrent from the danger point. As to the technique of this work, earth *bunds* lined with sandbags have been found the best and most economic after a certain amount of trial and error. *Kana* grass (*Saccharum munja*) and *Marwan* (*Vitex negundo*) are planted on the sides and in front of the spurs to control the current. In the still-water pockets formed between the spurs elephant grass (*Pennisatum purpureum*) has been planted with great success. A certain amount of tree planting (*e.g., Dalbergia sissoo* and *Salix* species) has also been done on comparatively high ground at the back and on islands in the *Kas* bed. Encouraged by this initial success, efforts are next directed towards straightening the stream some distance above Murid by means of short, well spaced spurs combined with planting so as to lead the current to a properly controlled channel in the middle of the present *Kas* bed. Reclamation of the sandy waste by planting is envisaged in the final stage after stabilising the stream bed.

Conclusion.—The gully plugging and stream training works in progress are valuable as an experiment. They have furnished a suitable demonstration of erosion control methods and soil conservation technique under local conditions. In the long run they are calculated to result in considerably modifying the attitude of the local peasantry towards forest conservancy and the proper use of land.

A NOTE ON THE DRYAGE OF SAL FUEL-WOOD

BY S. N. KAPUR AND M. A. REHMAN,

Wood Seasoning Section, Forest Research Institute, Dehra Dun.

Many enquiries are received from forest officers and fuel-wood merchants asking specific information relating to the percentage loss in weight of fuel-wood during storage. At the outset it may be stated that it is very difficult to give any definite figures of loss in weight, as it will naturally depend on the initial moisture content of fuel-wood at the time of stacking, nature of species, size of billets, whether they are whole or split, the time of stacking and the weather condition during storage. Information of this kind for any given species and locality can be made available by a comprehensive series of dryage tests carried out at that particular locality, but the question is not of such importance as to justify the undertaking of such tests. In most countries, fuel-wood is sold by volume and not by weight, the former being a more constant figure, not appreciably affected by dryage. If, therefore, figures for dry weight of stacked fuel of commercially important species in the country are ascertained, that information would be quite sufficient for retail dealers.

On the question of dryage of fuel-wood, the recorded information is very meagre. Mr. Naranjan Singh has given in the *Indian Forester* of May 1935, results of an experiment on the dryage of *Kosh* (*Alnus* sp.) firewood. He stacked split-wood as well as branch-wood in the forest in the month of March and found that both the lots of wood suffered a loss of about 33 to 37 per cent. in the first three months, *i.e.*, up to the end of the first dry weather. Thereafter, the experiment was continued for another six months, and the further loss of weight during this period amounted to only six per cent. It appears, therefore, that *Kosh* fuel-wood stacked in the month of March attains practically an air-dry condition in three months.

Mr. Brahmawar refers to the dryage of *banj* (*Quercus* sp.) and *burans* (*Rhododendron* sp.) fuel-wood during the period of storage in the *Working Plan for Pauri Fuel, Charcoal and Chir timber supply, Garhwal Forest Division, United Provinces,* where he gives results of an experiment carried out by him. He states that both *banj* and *burans* suffer a loss of about 10 to 11 per cent. when left stacked in the forest in the usual manner for a period of six months. The rate of drying is, however, much faster if the timber is stacked under a shed protected from rain. He found that after $10\frac{1}{2}$ months'

stacking *banj* fuel-wood lost 33 per cent. of its initial weight and *burans*, 60 per cent. According to Mr. Brahmawar, the average figure of loss due to dryage of fuel-wood during the usual stacking in the forest can be taken at 11 per cent., although he recommends that an allowance of up to 20 per cent. should be made to be on the safe side.

In order to have some more precise information on the question, two lots of sal fuel-wood, which were meant for use as fuel in the furnace kiln, were kept under observation at Dehra Dun. One of the experiments was started in December and the other in the month of May, so as to determine the rate and amount of drying of fuel-wood stacked during the winter and summer months respectively. In each of the two experiments, two separate stacks were made one of entire billets with bark on, and one of split-wood. The material was received from the forest in the form of whole billets, about three feet in length. The thicker billets were split, but the thinner billets were left whole. The fuel-wood was weighed and stacked with the least possible delay after receipt at the Institute. The stacking was done on the ground in one of the seasoning godowns at the Forest Research Institute, and the material was closely packed as is usually done with fuel-wood in the forest. The stacks were broken at certain irregular intervals for weighing and every time a stack was broken it was re-stacked without delay.

The results of dryage are given in the following tables:

TABLE I

DRYAGE OF SAL FUEL-WOOD, STACKED DURING WINTER

Date	Duration of drying, weeks	Moisture content, per cent.		Loss of weight, per cent.	
		Billets	Split-wood	Billets	Split-wood
1-12-36	..	99·6	85·8	..	..
4-1-37	5	88·6	62·2	5·5	12·7
17-2-37	11	53·4	42·8	23·1	23·2
5-4-37	18	34·7	24·6	32·5	32·9
15-6-37	28	10·2	12·0	44·8	39·7

TABLE II

DRYAGE OF SAL FUEL-WOOD, STACKED IN SUMMER

Date	Duration of drying weeks	Moisture content per cent.		Loss of weight, per cent.	
		Billets	Split-wood	Billets	Split-wood
15-5-37	..	45·0	50·5	..	..
3-8-37	11	30·9	24·4	9·7	20·0
18-10-37	22	25·3	22·2	13·6	18·9
21-12-37	31	21·0	20·2	16·5	20·2
10-2-38	38	21·8	21·0	16·0	19·6
26-4-38	50	12·8	11·9	22·2	25·7
10-6-38	56	10·3	13·4	23·9	24·7

DISCUSSION OF RESULTS

Experiment No. 1, started in December 1936.

The first lot of fuel-wood was received at the Institute at the end of November 1936, and it took about a week to cross-cut and split the billets. Since the climate of the place during this time of the year is mild, the wood did not lose much moisture during handling and splitting, the moisture content of billets at the time of stacking being 99.6 per cent. and that of split-wood, 85.8 per cent. The split-wood would of course lose a little more moisture during this period than the billets, and hence the difference in the initial moisture contents. The rate of drying was also faster in the case of split-wood than that of billets in the first five weeks, but thereafter both were nearly parallel. Up to the end of the dry weather, *i.e.*, in 28 weeks after stacking, the moisture content of fuel-wood was reduced to 10 to 12 per cent. and there was a total loss of 40 to 45 per cent. of the initial weight.

Experiment No. 2, started in May 1937.

The second lot of fuel-wood was received in the first week of May 1937. On account of the very dry climate at this time of the

year, the wood lost a good deal of moisture during cross-cutting, splitting and handling, which took about a week. The moisture content of this lot of wood at the time of stacking varied from 45 to 50 per cent. The split-wood lost most of the moisture in 11 weeks, showing a loss of 20 per cent. of the initial weight, whereas the billets continued losing weight for 31 weeks. After this initial loss of moisture, the weight remained more or less constant till the approach of the second dry weather, when the fuel-wood lost another six to seven per cent. of its weight, attaining an air-dry condition at 10 to 13 per cent. moisture. The total loss of weight in 56 weeks was about 24 per cent. of the original weight of the fuel-wood.

Conclusions.—The following general conclusions can be drawn from the results of these experiments:

(1) The initial moisture content of sal fuel-wood at the time of stacking varies with the season of the year. The fuel-wood stacked in the dry weather contains much less moisture than that stacked in the winter, on account of the rapid loss of moisture from the wood due to dry atmospheric conditions during the period that necessarily elapses between cutting of fuel-wood in the forest and its stacking at the depot.

(2) The final moisture content of fully dried fuel-wood varies between 10 and 14 per cent. at Dehra Dun. At other localities, it would depend upon the prevailing atmospheric conditions in the dry weather and it may be slightly more or less than this figure.

(3) If the wood is stacked for drying in the winter, it attains a fully air-dry condition at the end of the first dry weather. If stacked later in the dry weather (month of May) it must be left stacked for about a year to reach that condition.

(4) Split-wood dries more rapidly than whole billets with bark on. Naturally the thickness of billets also plays an important part in the rate of drying and so does the percentage of heartwood in the billets.

(5) The total loss of weight till final dryage would, of course, depend on the initial moisture content of the fuel-wood at the time of stacking. In the case of wood under these experiments, the winter-stacked wood lost 40 to 45 per cent. of its original weight and the summer-stacked wood 24 to 25 per cent.

(6) To bring down the moisture content of sal fuel-wood to 20 per cent., about five to six months' stacking is necessary for the fuel-wood, both whole billets and split-wood, if the wood is stacked in winter. For the wood stacked in summer, the whole billets require the same period or even a little longer, whereas the split-wood attains that moisture content in less than three months.

(7) The results described here apply to wood stacked in the usual close-piled stacks under cover, but they are not expected to differ greatly for fuel-wood stacked in the open.

SUMMARY

Results are described of the two experiments carried out at the Forest Research Institute, Dehra Dun, on the dryage of sal fuel-wood, in the form of whole billets as well as split-wood. The percentage loss of weight depends on the season of stacking and varies from 25 per cent. to 45 per cent. of the original weight. The material stacked in summer starts from a lower moisture content on account of loss of moisture before stacking due to dry weather condition. Split-wood dries more rapidly than whole billets. For complete drying to about 10 to 14 per cent. moisture content, six to 12 months are necessary.

FORESTS AND RURAL WELFARE

CENTRAL PROVINCES AND BERAR

By K. P. Sagreiya, I. F. S.

Rural Development is the talk of the day. Although the ultimate aim and the methods differ, the politician, the economist, the reformer and even the state are, as it were, vying with one another in their attempts at ameliorating the lot of the rural population. A

few observations on the rôle played by the forests in the life of the villagers and the contribution that the Forest Department could make in this philanthropic work, provided the necessary facilities of funds and staff are forthcoming, are, therefore, ventured.

The main requirements of the villagers are food for themselves and their livestock, agricultural implements, firewood, small timber for building huts, cattle-pens, carts, etc., and raw materials for cottage industries. Even a cursory examination of the family budget of a peasant will show that apart from such necessities of life as clothes, salt, etc., which have to be imported, for the bulk of his essential requirements such as timber, firewood, grazing grass, bamboos, thorns, fibre, edible fruits and even medicines, he is dependent on the neighbouring forest. Besides this, in the slack season of agriculture he has to depend for a living wage on forest works such as felling and fashioning of timber, collection of forest produce and its transport, or on local forest industries. Therefore, if the economic condition of the peasant has to be improved, it is imperative that his essential requirements should be made available at cheaper rates on the one hand, and on the other the forest products should be utilised to a greater extent through cottage industries. It is on these two aspects of rural development that this note purports to dwell in brief.

In the intensively cultivated areas there is a great scarcity of firewood and poles, so much so that otherwise well-to-do cultivators have to resort to using cow-dung as fuel, and to live in mud huts. Increasing difficulty is also being experienced in these tracts for obtaining adequate grazing for the cattle. The obvious remedy is the creation of tree-*cum*-fodder reserves in these localities. The method of afforestation known as "agri-silviculture," or to give it a popular name, *Ban kheti*, which has proved so successful in certain parts of Berar, deserves to be popularised, the existing method being suitably modified to provide greater quantities of nutritive fodder and better pastures. It must, however, be emphasised that a one-sided increase in the fodder supplies alone will not prove beneficial as is sometimes erroneously believed, because this will only give further incentive to the people to keep larger herds of uneconomic cattle which will become a serious drain on the fodder supplies. What is required is to improve the efficiency of the essential cattle and at

the same time to discourage promiscuous breeding of useless animals, if necessary by compulsory castration of emaciated bulls. We are apt to forget that our cattle are inefficient and degenerate through our own fault, *viz.*, under-nourishment and unregulated breeding. Slaughter of useless cattle which are a drain on the country is perhaps a lesser sin than the degeneration by underfeeding and promiscuous breeding of a race of animals who are literally the *Kamdhenus** of our country. If fuller feeding could be made available by reducing the number of animals and increasing the production of nutritive fodder and their quality could be improved by organised breeding, we could carry on our agriculture and increase the supply of milk, etc., with a very much smaller number. Reduction of surplus livestock by humane methods will be the greatest boon to the country. The obvious remedy is to commercialise the grazing and then to utilise the increased fees for intensively improving the depleted fodder reserves by weeding out non-fodder species, manuring and re-seeding with nutritive grasses and at the same time organising cattle breeding and production of cultivated fodder and concentrates. Similarly, to make better grazing available in the existing forests the present practice of continuous and unlimited grazing must be replaced by deferred grazing at a reasonable incidence. Storing of unutilised grass from remoter tracts in *Silo* pits and utilising it in the dry season for stall-feeding also deserves investigation, if necessary by making silage available at low rates.

As regards the occupations and industries which can help the rural population to supplement their earnings, the forests provide ample scope. Forest works such as construction of roads, buildings, wells and tanks in remoter tracts, making of plantations of valuable species, etc., which no doubt require initial expenses, the benefits from which in the shape of more profitable utilisation of forest resources do not accrue immediately, deserve to be encouraged. The money thus spent, apart from increasing the ultimate productivity of the forests, gives immediate relief to the under-employed peasantry, a fact which is often lost sight of. Of the skilled operations for which labour is generally imported those deserving of immediate attention are sawing, charcoal making, *katha* boiling and

* *Kamdhenu* is the celestial cow of Hindu mythology which gave all that its votary asked for.

cabinet making. Local labour can be trained and made to earn a higher wage on these industries. Similarly there are certain cottage industries which can be better organised provided the necessary funds and staff are available. These are making of sealing wax bangles and varnishes from lac, preparation of tannin extracts, collection of good seed, raising of plants for afforestation or arboriculture, collection of medicinal herbs and plants, better utilisation of bamboos, etc.

Finally we have the large-scale industries for a more profitable utilisation of our resources, such as manufacture of paper pulp, ply and laminated wood, matches, packing cases, bobbins, umbrella handles, electric transmission poles from unutilised woods by treating them with preservatives, etc. In short, given the necessary facilities, the forests can help the rural population to a very great extent to better their lot.

In this connection it might interest the reader to know the work done by the Government of the United Provinces during the last year. A conference held in December 1936, in Madras, for the better utilisation of forest grazing, under the chairmanship of the Inspector-General of Forests, recommended the formation of Fodder and Grazing Committees in the various provinces. The recommendation was subsequently accepted and emphasised by the Simla Cattle Conference (May 1937). In pursuance of this recommendation the United Provinces Government have appointed a committee containing representatives of the Revenue, Irrigation, Forest, Agriculture and Veterinary Departments. The Chief Conservator of Forests, United Provinces, is its Chairman.

The Committee has drawn up a comprehensive five-year research programme on the fodder and grazing problems in the province, which, among other things, includes soil survey, fuel and fodder survey, nutritive research improvement of grazing in *usar* and ravine lands and livestock improvement.

A forest officer has been appointed on special duty as Rural Development Officer, to explore the possibility, (*i*) of creating fuel and fodder plantations on culturable lands with the aid of field crops (to minimise the cost of formation), (*ii*) of improving fodder and grazing on a large scale on *usar* lands, (*iii*) of checking ravine erosion and improving fodder supplies by control of grazing.

The officer toured extensively and approached the zemindars, cultivators, district officers, tube-well and irrigation engineers and delivered popular lectures on rural development at various centres. As a result of this several zemindars set aside land for plantation and improvement of grazing grounds and ravine lands over which work of afforestation has already commenced. The chief species introduced in these plantations are *sissoo, tun, nim, mango, jamun, babul, baranga, bamboo,* and *sum* (*sabai*) grass to produce timber, fuel, green fodder, fruits, tanning bark and raw materials for various cottage industries, *e.g.*, making of cart wheels, ploughs, charpoys, baskets, chiks, rope, string, etc.

The basic idea is that whatever work is done shall be done by the villagers and zemindars themselves while the organisation of the Rural Development Department supplies the supervision and propaganda and the Forest Department supplies a gazetted forest officer and the necessary technical knowledge, supplies free tree seeds which are not available locally and trains special staff for the work of afforestation and utilisation of forest products.—*Hitawada, 4th June* 1939.

OIL FROM MECONOPSIS SEEDS

By B. N. Ghose

Mr. George Taylor, in his admirable book, "An Account of the Genus Meconopsis," stated that Meconopsis has no economic importance.

Bose and Kirtikar in their "Indian Medicinal Plants" attribute narcotic properties to the roots of *M. aculeata, M. napaulensis* and to *M. paniculata*. The dry roots of a Meconopsis appear to have been examined for medicinal properties but there is no record to show that the leaves, stems or seeds were also examined.

Meconopsis is allied to *Papaver somniferum* and is known as Himalayan poppy. It is much sought after on account of the beauty of its flowers.

Poppy (*P. somniferum*) is cultivated for opium. Opium is derived from the juice obtained by the superficial incision of the capsule and by its subsequent thickening owing to exposure. The

opium thus obtained contains, among other principles, morphine and supplies a most valuable drug. Taken in small doses it is a powerful stimulant, but taken in large doses it is a deadly poison. Orientals, specially the Chinese, drink, chew and smoke this in order that they may become intoxicated much to their physical and moral degradation. Bites of venomous snakes have no effect on one addicted to taking opium. The poppy seed has no intoxicating properties, but being rich in oil has a good flavour and is largely consumed in India for making sweet cakes and curries. The seed yields a sweet edible oil, devoid of any trace of opium. High grades are used for culinary purposes and the lower grades are employed as fuel and for lubrication. The oil is rendered colourless by exposure to the sun. It is suitable for mixing with paints and is a good drying oil. It is largely used by artists and fetches a good price. The cake is sweet and nutritious and is greedily eaten by cattle. It is also a valuable manure.

The petals of the field poppy are mucilagenous, emollient and slightly narcotic. Its ally *Chelidonium majus* yields yellow and acrid juice, destroys warts and is said to be efficacious against the bite of venomous snakes. The juice of *Argemone mexicana* (Mexican poppy) possesses, it is said, the same virtue. The stems of this are cooked and eaten as a salad in many parts of Bengal and Behar. It is said to be efficacious for those suffering from itches and other skin diseases. The oil extracted from the seed of this plant is also used for manufacturing soap.

Since poppy and Argemone yield oil, it might also be possible to obtain oil from the Meconopsis seed.

Both Prain and Gammie found that *Meconopsis grandis* was plentiful in the neighbourhood of Jongri and that the inhabitants obtained oil by expression of its seeds. It was consumed by herdsmen who graze yaks. Some consider that the oil thus obtained is as palatable as butter. Yaks graze in high pastures in summer and the milk yielded is turned to butter and whey. That with plenty of butter in their possession the graziers should still seek the oil of *Meconopsis* cannot fail to rouse one's curiosity. Collectors were, therefore, employed to secure seeds from Jongri to test the oil, but

the herdsmen of Jongri stated that the seeds of *M. grandis* were obtained originally from a place further westwards from Nepal territory and that they were never cultivated. The seeds originally brought from Nepal were totally consumed in extracting oil and the few that escaped and grew in the crevices of the stone walls of yak sheds and flourished in places inaccessible to both man and beast are no longer to be found. Travellers in search of this plant could not secure anything but a few stumps of old plants. No seeds could be obtained though men were sent in search for several successive seasons.

Having failed to obtain *Meconopsis grandis* oil, attention was paid to other *Meconopsis* seeds which were easily obtained. Professor N. C. Nag, M.A., F.I.C., Assistant Director, Bose Research Institute, Calcutta, took a keen interest and investigated the oil contents of three different *Meconopsis* and the results of his labours are already embodied in the transactions of the Bose Research Institute, Calcutta, Vol. X (1934-35). An extract from the summary is reproduced below.

The air-dried seeds were first crushed and then submitted to detailed examination. The results are given below:

Name	Oil yield per cent. of seed weight	Saponification value	Unsaponifiable matter	Iodine value	Acid value	R. M. value	Ash
Papaver somniferum	41·0	195	0·43	138·0	·9	0	..
M. napaulensis ..	26·22	181—187	0·62	130·3	40·6	0·21	8·80
M. Wallichii collected from Tonglu	34·2	182—2	0·91	128—7	14·2	8·32	5·00
M. Paniculata ..	32·5	187	1·06	125—2	32·0	..	..

The total nitrogen in the residue after oil extraction was about 3.7, which indicated a high protein content—and a high value as manure.

The oil extracted from Meconopsis is transparent and is of a light yellow colour. Kept in stoppered glass bottles, even in diffused sunlight, it gets bleached and becomes colourless. The oil quickly

absorbs oxygen, becomes thickened and increases in weight. The drying quality of the oil is very high indeed.

An artist of position holds that Meconopsis oil appears to have a great future and will make better artist's oil than poppy oil. *Meconopsis wallichii* seeds cultivated in the garden of Messrs. G. Ghose & Co., at Townend, Darjeeling, yielded as high as 44 per cent. of oil, whereas *Papaver somniferum* yields about 41.00 per cent. This is 10 per cent. more than that obtained from seeds of *M. wallichii* collected at Tonglu, 10,000 feet above sea level.

At such elevated places as Sandakphu and Phalut, trees and shrubs become stunted and the mountain tops are bleak and barren and are strewn with rocks and boulders. There are many wild and exposed spots where no shrubs or trees can exist. These large strips of grassy lands produced a profound impression upon my mind and I wondered whether such waste land, the home of Meconopsis, might not be turned to a profitable account by cultivating thereon *Meconopsis* on a large scale for the manufacture of artist's oil. Very little cultivation would be required. These waste lands at present provide only pasture for cattle. The summer is so short and the altitude so high that crops cannot mature so that these places cannot but lie fallow and can be but of little use to mankind.

Hooker in his Flora of British India states that *Meconopsis wallichii* is distinct from *M. napaulensis*. Prain in the Kew Bulletin (1915) states that it is not possible to treat *M. wallichii* as specifically distinct from *M. napaulensis*, yet he hesitated to declare these were one and the same.

The chemical analysis of the oils shown above shows a great alliance, but I do not know if they can be declared as identical.

Mr. George Taylor asserts that *M. wallichii* is identical with *M. napaulensis*. From the specimens I have gathered and those available at the local herbarium, I have seen that the flowering stem is much more branched in *M. wallichii* and that the capsules are much shorter and smaller and more clothed with persistently bristly hairs than are the *M. napaulensis*.

It would not be out of place to describe the conditions under which Meconopsis grow in the Singalela Range, which is within easy

reach of Darjeeling. This range springs from the snowy mountain of Kanchanjanga and runs southwards towards the plains of Bengal. It has innumerable flanking spurs deeply covered with vegetation. The earth is yellow loam, very slippery during the rains. There is no lime in the soil.

This range is under the influence of the monsoon and the rainfall is very excessive. The rain clouds that rise from the Bay of Bengal come under the influence of the southern slopes of the Assam Hills where they deposit a portion of their moisture. The lightened currents are deflected North-Westwards rising gradually as they move and strike in the temperate regions of the outer ranges of the Darjeeling Himalayas where they condense and give plenty of rain. Such directly explored slopes are extremely humid and the rainfall is not less than 150 inches a year. Rain falls without cessation from May to the end of September. The weather at this period is hot and the air is saturated with moisture and the sky overcast with clouds. On an average there may be two or three sunny days in a month during this period. In the dull wintry months the sun is not powerful enough to melt the snow that the higher ranges receive. March to May the sky is free from clouds and the sun is powerful enough to melt the snow and supply abundant moisture to the grass land that covers the ridges. It is well known that vegetation gives the soil humus which helps in the conservation of moisture, the wooded mountain slopes are covered with decayed fallen leaves that hold the water like a sponge. This moisture is slowly exhaled, keeping the wood in a moist condition. In sheltered positions and amongst thin wood *Meconopsis* thrive to perfection. Even when there is no rainfall the roots of *Meconopsis* never suffer from lack of humidity.

At Tonglu a small plot was cultivated and some young *Meconopsis* were planted; they flowered and gave a superabundant quantity of seeds. This seed was collected for Professor Nag for his laboratory experiments.

It seems to me that *Meconopsis* oil has a great future. It is true that *Meconopsis* seeds cannot be easily got in large quantities, at least in the neighbourhood of Darjeeling, but there is no reason why these cannot be cultivated in suitable localities in the Darjeeling Himalayas or in other temperate regions of the world.

TIMBER PRICE LIST, OCTOBER-NOVEMBER 1939
(ISSUED MONTHLY BY THE FOREST RESEARCH INSTITUTE).

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Baing ..	*Tetrameles nudiflora* ..	Assam ..	Logs ..	Rs. 30-0-0 per ton in Calcutta.
Benteak ..	*Lagerstrœmia lanceolata*	Bombay ..	Squares ..	Rs. 32-0-0 to 64-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 34-6-0 to 39-1-0 per ton.
Bijasal ..	*Pterocarpus marsupium*	Bombay ..	Logs ..	Rs. 52-0-0 to 84-0-0 per ton.
" ..	" ..	Madras ..	Logs ..	Rs. 50-0-0 to 61-0-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-9-0 to 1-6-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-9-0 to 1-0-0 per c.ft.
Blue pine ..	*Pinus excelsa* ..	N. W. F. P.	12′×10″×5″ ..	Rs. 4-6-0 per piece.
" ..	" ..	Punjab ..	12′×10″×5″ ..	Rs. 4-12-0 per piece.
Chir ..	*Pinus longifolia* ..	N. W. F. P.	9′×10″×5″ ..	Rs. 1-10-0 per piece.
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 2-14-0 per piece.
" ..	" ..	U. P. ..	9′×10″×5″ ..	Rs. 3-2-0 to 3-4-0 per sleeper.
Civit ..	*Swintonia floribunda* ..	Bengal ..	Logs ..	
Deodar ..	*Cedrus deodara* ..	Jhelum ..	Logs ..	
" ..	" ..	Punjab ..	9′×10″×5″ ..	Rs. 4-8-0 per piece.
Dhupa ..	*Vateria indica* ..	Madras ..	Logs ..	
Fir ..	*Abies & Picea* spp. ..	Punjab ..	10′×10″×5″ ..	Rs. 2-10-0 per piece.
Gamari ..	*Gmelina arborea* ..	Orissa ..	Logs ..	Re. 0-10-0 to 1-0-0 per c.ft.
Gurjan ..	*Dipterocarpus* spp. ..	Andamans ..	Squares ..	
" ..	" ..	Assam ..	Squares ..	Rs. 50-0-0 per ton.
" ..	" ..	Bengal ..	Logs ..	Rs. 30-0-0 to 35-0-0 per ton.
Haldu ..	*Adina cordifolia* ..	Assam ..	Squares ..	Rs. 53-2-0 per ton.
" ..	" ..	Bombay ..	Squares ..	Rs. 24-0-0 to 65-0-0 per ton.
" ..	" ..	C. P. ..	Squares ..	Re. 0-4-0 to 0-13-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 42-3-0 to 51-9-0 per ton.
" ..	" ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-4-0 to 0-10-0 per c.ft.
Hopea ..	*Hopea parviflora* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Indian Rosewood ..	*Dalbergia latifolia* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 90-0-0 per ton.
" ..	" ..	C. P. ..	Logs ..	Re. 1-0-0 to 1-2-0 per c.ft.
" ..	" ..	Orissa ..	Logs ..	Re. 0-12-0 to 1-0-0 per c.ft.
" ..	" ..	Madras ..	Logs ..	Rs. 80-0-0 to 100-0-0 per ton.
Irul ..	*Xylia xylocarpa* ..	Madras ..	B. G. sleepers	Rs. 6-0-0 each.
Kindal ..	*Terminalia paniculata* ..	Madras ..	Logs ..	Rs. 43-12-0 per ton.

Trade or Common name.	Species.	Locality.	Description of timber.	Prices.
1	2	3	4	5
Laurel ..	*Terminalia tomentosa* ..	Bombay ..	Logs ..	Rs. 48-0-0 to 60-0-0 per ton.
,, ..	,, ..	C. P. ..	Squares ..	Re. 0-12-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-6-0 to 0-8-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 0-10-0 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 40-14-0 to 50-0-0 per ton.
Mesua ..	*Mesua ferrea* ..	Madras ..	B. G. sleepers..	Rs. 6-0-0 each.
Mulberry ..	*Morus alba* ..	Punjab ..	Logs ..	
Padauk ..	*Pterocarpus dalbergioides*	Andamans ..	Squares ..	
Sal ..	*Shorea robusta* ..	Assam ..	Logs ..	Rs. 31-4-0 to 62-8-0 per ton.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-12-0 each.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-9-3 each.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 20-0-0 to 75-0-0 per ton.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-7-0 to 1-4-0 per c.ft.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 5-4-0 to 5-8-0 per sleeper.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-1-0 to 2-5-0 per sleeper.
,, ..	,, ..	C. P. ..	Logs ..	Rs. 1-2-0 to 1-4-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-6-0 to 1-0-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs	Re. 1-2-0 to 1-6-0 per c.ft.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 2-4-0 to 2-8-0 per sleeper.
,, ..	,, ..	,, ..	B. G. sleepers	Rs. 4-14-0 to 6-0-0 per sleeper.
Sandalwood ..	*Santalum album* ..	Madras ..	Billets ..	Rs. 306-0-0 to 639-0-0 per ton.
Sandan ..	*Ougeinia dalbergioides* ..	C. P. ..	Logs ..	Re. 0-14-0 to 1-2-0 per c.ft.
,, ..	,, ..	Bihar ..	Logs ..	Re. 0-8-0 to 0-9-0 per c.ft.
,, ..	,, ..	Orissa ..	Logs ..	Re. 0-12-0 per c.ft.
Semul ..	*Bombax malabaricum* ..	Assam ..	Logs ..	Rs. 35-0-0 per ton in Calcutta.
,, ..	,, ..	Bihar ..	Scantlings ..	Re. 0-4-0 to 0-6-0 per c.ft.
,, ..	,, ..	Madras ..	Logs	
Sissoo ..	*Dalbergia sissoo* ..	Punjab ..	Logs	Re. 0-11-0 to 1-0-0 per c.ft.
,, ..	,, ..	U. P. ..	Logs ..	Re. 0-12-0 to 1-6-6 per c.ft.
,, ..	,, ..	Bengal ..	Logs ..	Rs. 35-0-0 to 75-0-0 per ton.
Sundri ..	*Heritiera* spp. ..	Bengal ..	Logs ..	Rs. 20-0-0 to 25-0-0 per ton.
Teak ..	*Tectona grandis* ..	Calcutta ..	Logs 1st class	
,, ..	,, ..	,, ..	Logs 2nd class	
,, ..	,, ..	C. P. ..	Logs ..	Re. 0-13-3 to 2-4-2 per c.ft.
,, ..	,, ..	,, ..	Squares ..	Rs. 1-8-4 to 3-1-4 per c.ft.
,, ..	,, ..	Madras ..	Logs ..	Rs. 68-12-0 to 114-1-0 per ton.
,, ..	,, ..	Bombay ..	Logs ..	Rs. 67-0-0 to 160-0-0 per ton.
,, ..	,, ..	,, ..	M. G. sleepers	Rs. 3-14-0 each.
White dhup ..	*Canarium euphyllum* ..	Andamans ..	Logs	

REVIEWS AND ABSTRACTS

(1) AN OUTLINE OF FORESTRY

BY THOMAS THOMSON AND M. R. K. JERRAM.

[*Thos. Murby & Co., London.* 1938: *pp.* 208, *plates* 3. 7*s.* 6*d.*]

(2) AN OUTLINE OF GENERAL FORESTRY

BY JOSEPH S. ILLICK.

[*Barnes & Noble, Inc., New York.* 3*rd edition,* 1939: *pp.* 297. *Paper,* $1.00, *Cloth,* $1.50.]

Although similar in title and object, these two books are in many respects very dissimilar. The authors of the first are Head of, and Assistant Lecturer in, the Department of Forestry, University College of N. Wales, Bangor, while the author of the second is Professor of Forest Management, New York State College of Forestry at Syracuse University, U.S.A. Jerram was formerly in the Indian Forest Service, and Illick was formerly State Forester of Pennsylvania. Both books have, therefore, been written by men of practical and educational experience in the realm of Forestry, which is much in their favour, and it may be said at the outset, lest any subsequent criticisms be misunderstood, that although they differ very considerably, each in its own way is a good book.

Thomson and Jerram explain that their book makes "no claim to be considered as a text-book on forestry or any branch thereof." It is "to provide for students on their initial approach to the subject, an explanatory outline of the kind of knowledge they will have to acquire, and to place them on the road to the asking of the right questions." At the same time, it is hoped that it will dispel ignorance "and prove useful to those laymen who are interested in the subject and have a serious desire to know what it is all about."

Illick, likewise, explains that his book "is not intended as a complete text-book," and that "while intended primarily for students of forestry, it should also be of real service to laymen and forest workers." It is intended "as a guide to a general understanding of what forestry is, how it is developing, what it is doing, where it is heading, why it is needed, and the benefits it is bringing to mankind." It is meant to stimulate thoughtful discussion and additional reading and study and to open up an understanding of

the aims and purposes of the general practice and the more specialised fields of forestry. In these respects its scope is very much wider than that of Thomson and Jerram's book, and the range of subjects dealt with is correspondingly much greater.

Thomson and Jerram have limited their book to an outline of the conventional branches of forest education. It is divided into four parts: Part I—Forest Policy (a brief summary covering eight pages only); Part II—Forest Binomics, including Silviculture and Protection; Part III--Forest Economics, comprising Valuation and Finance, Mensuration and Utilisation, and Part IV—Forest Management. The Foundations and Practice of Silviculture in Part II occupy half the book, and as the type is fairly small a great deal of information is included, some of which one would hardly expect in an *Outline of Forestry*. For the student, there will possibly be a temptation to treat this part of the book as a text-book, to be supplemented by lecture notes, rather than to consider it simply as an outline for his further studies, while for the layman, the detail given may perhaps detract from the general readableness of the book.

Protection, Valuation and Finance, Mensuration, Utilisation, Management and Working Plans together occupy only the same space as is allotted to Silviculture, and have therefore been much more briefly dealt with. The condensation has on the whole been very well done, although in places the technical details given might again perhaps put off the general reader, while the student could have been left to obtain them from his more detailed text-books.

Illick's book can make no claim to be such a concise account of the various branches of the science of forestry. But on the other hand it is packed with general information which will be of interest both to the student and to the lay public of the U. S. A., for whom it is written. It is divided into thirty-one short chapters. The first five deal generally with Forests, Forestry and Trees, and with the Forest Resources of the World. Then follow a number of chapters dealing wih American Forests, Forestry and the Lumber Industry in particular, and with the Federal, State and other Forest Services. One hundred pages, *i.e.*, over one-third of the book, are then devoted to the science of forestry—Protection, Silviculture, Management, Improvement, Utilisation, Mensuration, etc. The last quarter of the book deals with Forest Research and Education, Employment

in Forestry, the Life and work of a Forester and Forest Administration, and ends with short chapters on Forestry in Other Countries (under India, Dehra Dun and the *Indian Forester* are mentioned), and on present-day Significant Trends in American Forestry.

Such a wide range of subjects, combined with the easy style of writing, makes the book very readable, and it gives one a very good idea of the present state of forestry in the United States. Tabular statements, diagrams, sketches and maps are plentifully scattered throughout the book, adding much to its lucidity. In many places, however, the information given is so condensed that it takes the form only of a list of headings, which will probably not be understood except by the forester or forest worker or without reference to other books. Thus, to mention only a few examples, the list of parts of tree stems, the list of the more important methods of reproduction and the list of mensuration instruments, all given without further explanation, will probably not be understandable to the general reader. They illustrate the breadth and diversity of the subjects and may stimulate further study, but for the lay reader very brief explanations of the general principles might perhaps have been usefully given.

A very useful feature of the book is the list of Selected References given at the end of each chapter. A set of questions is also given at the end of each chatper. They are elementary and are answerable from the material given in the book. They would be of value for elementary classes of forest subordinates or workers, or for the layman, and one imagines they are not really intended for the serious student.

Illick's book is thus very broad, but not so deep as Thomson and Jerram's. As a type, it is more likely, therefore, to appeal to the layman. Since this is the third edition in less than four years, its value has presumably been recognised by the American public. While it deals primarily with American conditions, it contains so much general information that it should appeal to a wider public in other countries. There is need for a book of this sort in all countries where forest propaganda needs pushing. Thomson and Jerram's book, on the other hand, will appeal to those more deeply and seriously interested in the science of Forestry and will enable

them to understand more fully the bases on which Forestry is laid and the theory and practice of its various branches.

Both books are well produced and are reasonably priced. They are worthy of perusal by the trained forester, and he may find them invaluable books to lend to those who so frequently ask him what forestry is all about and what he does for his living.

E. C. M.

EXTRACTS

PROGRESSIVE BIHAR

The constitution of a Provincial Forest Board by the Government of Bihar, announced last week in the *Bihar Gazette*, is proof of the Congress Government's concern to utilise to its fullest the possibilities of the forests in the province. Dr. Mahmud's anxiety to further industries in his province, both of the cottage and the factory type, found expression last year in his calling a conference of the Directors of Industries in the rest of India, with a view to considering the best possible way in which the resources of the country could be developed. The conference did not meet as he had originally contemplated, but since then, the National Planning Committee has come into existence and endeavours are in progress to pool the country's resources, and several sub-committees are just now considering special issues. Answers to the questionnaire issued by the parent committee have come in from various quarters, and when the committee meets next, we will be enabled to know the progress that has been made in drawing up a comprehensive scheme for the careful exploitation of existing raw materials. It is unfortunate that a man of the capacity and drive of Mr. Kumarappa should have resigned from the committee on the issue of cottage industries *versus*

large-scale factory industries, but, with his abiding interest in the rural betterment programme, it is obvious that, so far as cottage industries are concerned, his active help and co-operation will even now be available.

The Bihar Advisory Board is a sequel to the appointment of the Central Advisory Board on Forest Utilisation, and will be in the closest touch with that body and, through it, with the Dehra Dun Forest Research Institute, which, within recent years, has done a great deal to revive interest in the great possibilities of our forest wealth. A permanent timber demonstration exhibition in Patna, and the spread of technical knowledge about timber and other forest produce, are bound to pave the way for the setting up of a large number of cottage industries which, while providing work and wages for large numbers of the population, will go to swell the revenues of the province. The inclusion of timber engineering and wood preservation in the engineering colleges and schools is likewise calculated to create active interest in the use of wood for purposes for which until now steel and iron were considered essential. The Chairman of the Board is to be the Premier of Bihar, and amongst its personnel are to be representatives of railways, the Bihar Chamber of Commerce, private owners of forests, the University and the Departments of Agriculture, Public Works and Industries. Wisely conserved and utilised, the wealth of our forests can be made to add to the well-being of the population in a considerable measure. Even the so-called minor forest produce will amount to a substantial total, if those in charge of forest administration make the fullest use of their opportunities.—*The Hindustan Times,* September 19, 1939.

PROVINCIAL FOREST BOARD

To utilise forest produce for commercial and industrial purposes the Central Government decided recently to set up a Central Advisory Board on Forest Utilisation and the Bihar Government have now set up a Provincial Advisory Board of their own to reap the best advantage from such a Central Board as also to provide a link between their Forest Department and the industries for the greater industrial utilisation of their forest products. Forests are sources of

great wealth if they can be properly utilised and it is well that attention is at last being directed to the most advantageous utilisation of their products. While welcoming, however, the appointment of this Utilisation Advisory Board, we would take the opportunity once again of emphasising the need of having also an Afforestation branch of the Forest Department for the purpose of planting more forests and making up for the depletion going on constantly for one purpose or another. The forest area in the province is undoubtedly dwindling with harmful effect on the economic condition of the people and steps have to be taken not only to check the process but actually to extend the forest areas on a well-planned basis throughout the province.—*The Searchlight*, September 17, 1939.

DISCIPLINE IN FREEDOM

The three lectures which Lord Baldwin delivered at Toronto in April last, inaugurating the lectureship founded in memory of Sir Robert Falconer, have distinct claims on the attention of scientific workers. His analysis of the ideals and dangers of democracy and of the opposing forces at the present time both clarifies the fundamental issues and sounds a call to service to which men of science will not wish to be indifferent.

The supreme task, Lord Baldwin asserted, is that of combining freedom and discipline; in these lectures he adds one more voice to the many that have summoned scientific workers and their fellows to the defence of freedom of thought and speech and to the necessity of self-discipline and spontaneous service in order to enable the survival of our ideals. Lord Baldwin also insists on the necessity for having regard to the trends of our modern industrial system, for a wide perspective and not partial or biased views, and for imaginative handling of the possibilities which physiological knowledge and medical science offer us of eliminating some of the fundamental causes of industrial unrest by minimising the strain or stress due to speed or monotony.

Here indeed is scope for further investigation, and not even the immediate exigencies of national defence should be allowed to stand in the way of increased effort in such fields as those in which the National Institute of Industrial Psychology and the Industrial

Health Research Board are working. The work of the latter Board, it should be remembered, owes its origin to endeavours to safeguard the health of munition workers and increase their efficiency. A national defence policy must have full regard to the health of those who answer the call to national service, whether in working or in leisure hours. The careless destruction of amenities may have serious consequences to the national efficiency or morale in more ways than one. The protests against the proposal to erect a steel works in the Edale district find strong justification in the threat the proposal may well involve to the health of the industrial populations which have benefited so much from the availability of that district for recreation.

This is indeed a particular aspect of the problem of maintaining standards, which Lord Baldwin reminds us is an ever-present danger in a democracy. The coalition of paganism and machinery which makes the situation grave to-day challenges almost every one of the essential values cherished in a democracy—human personality, freedom and truth. Universities have their special responsibilities in maintaining those standards, and, above all, in supplying leaders who will be loyal to them and adamant in their service. The pursuit of intellectual truth is the chief object of university training, as the advancement of knowledge is one of the chief functions of a university.

The logical sequel to the pursuit of intellectual truth in the university is that the community is entitled to expect those leaving a university to have trained minds able to give dispassionate consideration to varied problems. This point was made by Sir Robert Pickard, Vice-Chancellor of the University of London, in addressing the new graduates at the annual degree-giving ceremony last month. He warned them that their academic distinctions were based mainly upon book learning, and gave them no claim to special consideration, except in so far as their training had taught them to develop unprejudiced minds able to weigh evidence. Such critical interest in world affairs is indeed the plain duty of all thoughtful men.

Sir Robert Pickard also referred to the attacks which have been made in recent years upon mental freedom. A constant desire for truth, a hunger for knowledge, a balanced judgment and earnest consideration for the views of others who might not share their

views on different problems, these are the hall-marks of a truly educated man. This attitude can only be achieved in an atmosphere of academic freedom, wherein the mind can follow the pursuit of knowledge untrammelled by the dictates of State or other institutions. Without mental freedom, Sir Robert rightly said, humanity and civilisation must surely perish. It is a precious gift which all who cherish learning would wish to hand on undiminished in value to succeeding generations.

Nevertheless, the path of knowledge, as Sir David Munro pointed out in his rectorial address at St. Andrews, is a disciplined path. The freedom we still possess in Great Britain to think for ourselves, to study the particular fields of knowledge that interest us, to act fearlessly on the dictates of our opinions and ideals involves discipline of the mind as well as of the body. Lack of self-discipline, Sir David Munro asserted, is what most endangers freedom.

The discipline and freedom of our schools and universities are not always enough to develop innate qualities of leadership. Sir David Munro pointed out that sometimes neither school nor college life fosters the eagerness and zest for life without which freedom is an empty gift and there is little worth disciplining. Such failure does not always lie in missed opportunities or in the biological make-up of the individual. What is lacking is interest or desire, in default of which faculties lie dormant and the tide of life runs low. Zest, he contended, is what matters; but without discipline it is unbridled, and without freedom it is stifled.

Nor is this reminder one for youth alone. It may be that youth has its special advantages and opportunities to be experimental. One of democracy's greatest needs to-day is for creative minds, willing and able to experiment wisely and constructively. The root cause of our failure to develop the new technique of social control which Lord Baldwin desiderated is this lack of zest and lack of interest in the social consequences of scientific discovery on the part of scientific workers themselves. That indifference is passing, but until disciplined enthusiasm in such matters is characteristic of the overwhelming majority of scientific workers, we can scarcely hope to progress at the rate desired.

What we have yet to take account of is the changed condition of the struggle. New social techniques are available for directing

mass behaviour in obedience to one man's will; new economic techniques for the industrial regimentation of the workers; new financial techniques for the ruthless taxation of rich and poor, for the plunder of aliens and the enemy within the gates. Plans can be prepared in secret and applied overnight for the enslavement of a whole nation and for the swift incarceration of its leaders by the hundred or by the thousand as required.

Conditions such as these impose on all democracies the necessity of attaining new levels of technical efficiency for self-defence and in co-operation. Moreover, there must be a devotion to the ideals of social justice and individual freedom inspired by a passion and zest for life which more than match the idolatrous worship of the State and brute force in the totalitarian countries. Grave as may be the threat which the menace of war offers to the world at the moment, if those in whose hands the defence of truth and freedom still remains are inspired, not by academic loyalty, but by a passionate zest for life, the danger may yet be averted, and advances in the standards of life for multitudes which social and scientific progress have made possible may be realised.

This is, above all, a question of leadership. It is not to be achieved by the pursuit of academic freedom as a thing apart from life, but by unflinching devotion to whatever that service and quest may involve in the social and political world, no less than within the walls of a university or laboratory. It demands that scientific workers themselves be willing to seek out and deal with all that restricts the full freedom of investigation or exposition and interpretation, or retards the application of the results of their work in the service of mankind. It means in practice the close study or investigation of many problems or even whole fields as yet largely unexplored. It means the acceptance of responsibilities for leadership and service and the development of such capacities, no less than of technical or scientific qualifications. But it involves, above all, an enthusiasm, a zest for life, a vision and sense of values and loyalty to ideals implicit alike in real leadership and in that moral disarmament for which the call was issued with the appeal for national service.—*Nature,* Vol. 143, No. 3633, dated the 17th June 1939.

DOES RESEARCH PAY AND WHAT CAN RESEARCH DO WITH WOOD ?

That research pays is evident from the multitude of new products, new processes and new industries developed, not by accidental discovery, but by laborious, long, systematic exploration. The experience of most great industries has led to a dependence upon the research division so that it has become a basic fundamental part of the organisation. The steel and associated industries spend hundreds of thousands of dollars in improving the properties of their products and extending their uses. Steel pre-fabricated houses are but one resultant threat to the lumber industry. Research has developed and is continuing to expand the various fibre boards, waterproof bonded plywood and plastics in all manner of uses. Plastics have been made into furniture and interior veneer finishes on mineral composition and metal bases. One large company has done extensive research in successfully developing a substitute for wood in the form of a fireproof sheet material for walls. It is used as an outer surface over an interior steel structure.

Companies which maintain or increase their research activities during periods of depression are often well rewarded by direct advantages. The Canadian nickel industry is an example. With business at a standstill after the war, it undertook a vigorous research and development programme which brought it back stronger than ever.

What research can do for other materials and other industries it can undoubtedly do for wood. We are not without examples, a few including the simple process for treating lumber to prevent blue stain, the successful process developed by the Western Pine Association for the preservative treatment of exterior mill-work, sugar and alcohol from waste wood in Germany, laminated beams and timbers, timber connectors resulting in a much greater efficiency of construction, lighter and stronger box construction, producer gas from wood for power, insulating fibre from redwood bark and a wood plastic.

There are also many developments in the laboratory stage which offer excellent possibilities for commercial production. Some of these include bonded synthetic boards for containers and other uses, impregnation of lumber to prevent shrinkage and swelling and various wood plastics.

Research is a slow process involving an investment over a period of years. However, given the required facilities, the necessary co-operation and proper direction, the returns are usually high. Research is not a luxury, yet it is not a panacea for all ills, nor an Alladin's lamp. Properly organised, equipped and directed, it is a sound investment.

The inauguration of a research programme should be preceded by careful thought and study, each individual project should be critically analysed and a thorough survey should be made covering all possible factors, including the following:

(*a*) Technical problems dealing with present products and processes.

(*b*) Types and amounts of raw materials (wastes, species, etc.), which may be made available at low unit cost for the manufacture of products other than lumber.

(*c*) Survey of the possible practical application of research data known and reported in the literature.

(*d*) Possible new products and processes (as yet undeveloped) which might particularly well fit the local conditions for manufacture.

(*e*) Actual and potential markets for new products.

(*f*) Careful estimates of probable costs and returns.

The research programme may be carried out in adequate laboratories maintained by the industry. Such laboratories may be organised by individual companies or by associations of lumber companies. In the latter plan, the work is available to all the member companies.

If a lumber company or association prefers not to establish a laboratory because of the investment and operating costs, and the availability of suitable facilities elsewhere, it may set aside funds for research projects to be carried out at selected research institutions, universities and government laboratories. Selection of the research agency should be made on the basis of the facilities available for the particular work in mind, the experience of the personnel in the field of work and the time which it may devote to directing or carrying out the work. The nature of the problem, whether

patents are involved and other questions should be considered in the choice of a research agency. In all cases a close co-operation should be maintained between the industry and the research agency.

Time is often an unpredictable element in research. It is generally considered that an average of seven years is covered in the development of a process from the laboratory to industrial actuality. Between the laboratory and the plant there is the semi-plant scale of research which is often of equal importance to the laboratory stage. It is this phase of the research which largely determines the practicality of a process and whether or not it may become profitable.

The pursuit of an intelligent research programme by the lumber industry should enable it to recoup some of its past losses and to improve the position of wood as an industrial raw material.—*Journal of Forestry*, Vol. 37, No. 8, dated August 1939.

CHARCOAL BURNING

THE USE OF PORTABLE METAL KILNS

There has been of late—for a number of reasons—a revival of interest in charcoal-burning, and as skilled charcoal-burners are as rare these days as expert thatchers and hedgers, the use of portable metal kilns has become more and more widespread. Therefore, in undertaking the investigations described by Mr. G. H. Donald in "The Manufacture of Charcoal in Portable Kilns" (Forest Products Research Records—No. 29: Stationary Office, 6*d*. net), the Princes Risborough Laboratory has performed a most useful piece of work.

The publication, as Mr. W. A. Robertson, the Director, makes clear, in a prefatory note, is not intended to be a manual on charcoal-burning, but "it does bring out what are the essential conditions which must be observed and shows that, if they are observed, a quality of charcoal can be produced entirely suitable for transport and general industrial requirements."

Before the Laboratory began investigations little attention had been paid by scientists to the art of charcoal-burning, and the threefold objects of the investigation were drawn up so as to cover a wide field. They included the determination of how to produce charcoal; to ascertain how to obtain the maximum yield; and to evolve

simplified directions for the operation of portable kilns which could be easily applied by semi-skilled labour.

The investigations brought to light a number of facts and exploded several widely held fallacies. It was proved, for example that the inclusion of billets of varying thicknesses tends towards uneven carbonisation; that more satisfactory results, particularly as regards evenness of burning, are obtained by regulating the outlet flues, instead of the inlets, as is so often recommended; that for most dry cord-wood discs of 1/8-inch steel or iron plate with two-inch holes bored through make very satisfactory "dampers" for the outlet flues; that rather more charcoal can be made per burn by omitting the "flash-up," but only at the sacrifice of quality; and it is charcoal of low volatile content that must be made.

Although of necessity rather technical in parts, the publication is clearly written, and extends to 20 pages. The results of 24 experimental burnings are given as an appendix. The author concludes by pointing out that the record is merely an interim report, and that other reports will follow.—*The Timber Trades Journal*, Vol. CL. No. 3282, dated July 22, 1939.

JOHN EVELYN: FORESTER EXTRAORDINARY

All the older professions and sciences have established historical backgrounds. Members of such professions and scientific groups are intensely proud of the achievements of their great and near-great. Who among the physicists, for example, does not know of Archimedes, of Galileo, of Sir Isaac Newton, of James Clerk-Maxwell, of Sir William Thompson, of Count Volta, of Michael Faraday, and of J. J. Thompson? Who among the plant pathologists does not know of Fabricius, of De Bary, of Kühn, of O. Brefeld, of Robert Koch, of the Tulasne brothers, of Sorauer, of Marshall Ward, and of E. F. Smith? Who in medicine does not know of Hippocrates, of Paré, of William Harvey, of Edward Jenner, of O. W. Holmes, of Pasteur, and of Sir William Osler? What chemist does not know of Lavoisier, of Sir Humphrey Davy, of Dalton, of Mendeléef, of Liebig, of Wöhler, of Kekulé, and of Mosley?

Why should not foresters be equally familiar and take equal pride in the achievements of John Evelyn, of Zanthier, of George Ludwig Hartig, of Cotta, of Hundeshagen, of Heyer, of Duhamel, of Lorentz, of Huffel, of Schlich, of John C. Brown and of many others? It may well be that not all these men compare in intellectual stature with the great chemists, physicists, physicians or botanists. Nevertheless, it is certain that they have made scientific or professional contributions of no small import. Still more certain is it that some of these names would be included in any list of outstanding scientists and technicians of the past. Most certain is it that John Evelyn, because of the breadth of his scholarship, his wide interests and achievements in many fields of learning, must be regarded as a truly great man.

John Evelyn is probably best known as a diarist. He might also well be considered an historian. If occasion should so demand, John Evelyn might be classed as a political leader of his time, or as a Greek scholar, or, better still, a traveller. In fact, John Evelyn is difficult to classify. Foresters should regard him as a forester.

John Evelyn was the second son and the fourth child of Richard Evelyn and his wife Eleanor. He was born in Watton, England, on October 31, 1620. From the age of eleven onward and down to the month of his death, he kept a diary, as did his father before him. Because of this diary the record of Evelyn's life, despite its fullness and complexity, is unusually complete.

Foresters may legitimately lay claim to Evelyn as a forester because of his book *Sylva or A Discourse of Forest Trees,* published in 1664. *Sylva* is undoubtedly one of the greatest, if not the greatest, of Evelyn's literary works. Few if any men or books so profoundly influenced the course of forestry in any country as John Evelyn and his *Sylva* influenced the course of forestry in England. In order fully to appreciate the significance of Evelyn's contribution to English forestry, it is necessary to consider briefly the forest history of England.

There is considerable evidence for the belief that originally the greater part of the British Isles was covered by extensive forests. Even at the time of the Roman invasion, they were for the most

part covered. As the population increased, there was a corresponding increase in agricultural acreage at the expense of the forest area. The destruction of the forest would have been still greater and more complete had it not been for the fact that large forest areas were reserved for the king and his nobles for the chase. During the reign of Edward I, however, the area of royal forest land was greatly reduced to provide additional agricultural land because the plight of the rural population had become unbearable.

By 1482 the government had become very apprehensive because the rapid rate at which the forests were disappearing threatened an adequate supply of oak naval timber. Through various statutes the forest area and timber supply of the country were increased, only to be largely destroyed during the reign of Henry VIII and during the Civil War. Between 1642 and the Restoration, the situation had become critical enough to cause general alarm.

About this time Evelyn and his friend Robert Boyle became interested in founding a philosophical and mathematical society, which did not materialise because of the Restoration. A little later, however, these same men were among the most prominent of the founders of the Royal Society. At least three or four times during his life Evelyn was asked to accept the presidency of that society, but on each occasion he declined.

On October 15, 1662, Evelyn records in his diary that:

"I this day deliver'd my 'Discourse concerning Forest Trees' to the society, on occasion of certain queries sent to us by the Commissioner of his Majesties Navy, being first booke that was printed by order of the society, and their printer, since it was a corporation."

It should be a source of no little gratification to foresters that apparently the first publication authorised by the most distinguished scientific society in the world dealt with the subject of forestry.

Evelyn's *Sylva* is truly a significant book. It was published under the auspices of a society which even in those days was great; it was dedicated to the King; it was timely; and it espoused a worthy cause. That it bore fruit is evidenced by the fact that four years after its publication Evelyn was able to report to his King that "millions of trees had been planted."

Space does not permit considering even a small part of John Evelyn's accomplishments. Had Evelyn been a physicist, as his friend and contemporary Robert Boyle, his name would be as hallowed among physicists as is that of Boyle. Had he been a physician, his name would still be as well known among physicians as is that of William Harvey, who also was a friend and contemporary of John Evelyn. But in a very real sense John Evelyn was a forester—self-taught, to be sure—and unfortunately his name is all but forgotten among the rank and file of foresters.

The statement is often made that forestry has become of age. In a physical and economic sense this is perhaps true. In a spiritual and intellectual sense it is not so evident. Forestry will never become of age intellectually until the great names in forestry are as well known and highly respected among foresters as the great names in other fields of learning are known and respected in those fields of learning. Foresters must grow in intellectual stature. They must develop and establish the historical background not only of the science but of the practice of forestry. As a beginning, let us claim John Evelyn as a forester, despite the fact that others may also lay claim on him. By so doing we will add greatly to the dignity and prestige of our profession.—Editorial, *Journal of Forestry*, Vol. 37, No. 1, dated January 1939.

PRESIDENT URGES REFORESTING NORTHERN CUT-OVER LAKE AREA

BY A STAFF CORRESPONDENT OF "THE CHRISTIAN SCIENCE MONITOR," DATED THE 1st AUGUST 1939.

Washington, Aug. 1—President Roosevelt yesterday transmitted to Congress with a message, a report by the National Resources Committee designed to improve social and economic conditions in one of the stranded areas of the United States—a region half again as large as the New England States—the cut-over area of northern Minnesota, Wisconsin, and Michigan.

Here lives a population of 1,500,000, left in the wake of axes and the sawmills, without adequate employment, striving to cultivate land much of which is unsuited for agriculture, pluckily coping

with problems that have been too great for their individual efforts. Relief of various kinds has been poured into the region, without doing anything except palliate conditions.

Now the National Resources Committee has worked out a program by which the residents of the cut-over area themselves, helped by State and Federal Governments, may find their way back to security and independence. Rather than considering migration of these stranded people to other areas, it is proposed to make their own region a self-supporting district.

This may be accomplished, the report advises, through the restoration of the forest resources by the beginning of proper conservation methods, the improvement of lakes, streams, and other recreational facilities, the rational development of the mining industry, the movement of isolated settlers and those on very low-grade soils to locations providing equal or better economic opportunity where public services can be provided at reduced cost, improvement in current farm practices, and reforms in local governmental organization and procedure.

In starting forest protection and development, it is proposed to provide work opportunities for local unemployed in small camps and non-camp projects by existing state and federal conservation agencies. Farmers are to be helped by re-location, or—more desirable—by assistance in clearing areas, furnishing sound loans for development, co-operative marketing, and aid in building economically better farm buildings.

State legislation is recommended, in one interesting and untouched field, to eliminate many uneconomic units of government. It is proposed that the County take over town roads, school and assessment districts be enlarged, and counties made responsible for health and welfare activities.

Few, if any, similarly large areas in the United States, says the report, have more wild land and water area in proportion to the populations. Much of this should never be farmed, but forests can give employment to many if properly conserved. Repeated fires have prevented reproduction in many areas, but better protection is now helping nature to do "a pretty good job of restoration. It will continue to do so, if fire protection improves and young stands are not prematurely cut."

In developing recreational facilities, it is proposed that certain public areas be dedicated as wilderness or primitive areas with few if any man-made improvements allowed. It is also suggested "to provide recreational facilities on publicly owned land for organized groups."

The report concludes:

"The problems of the region, though aggravated and intensified by the recent depression, existed before 1929. They demand prompt and effective solution in order to effect the desirable rehabilitation of the region and to avoid greater retrogression. The region is worth rehabilitating. It goes without saying that the local people should help themselves, but the States and the Nation have enough of a stake in the region to make it worth while to lend a hand. Most of the machinery to do the job is now set up and in motion. It should be kept moving.

There is a sound basis for optimism. . . . It is fair to assume that the future way of life for the people in this region will be an attractive one. It will not be easy or simple, but it will be a better way."—*Received from Dr. R. M. Gorrie, Hoshiarpur Siwaliks Division, Hoshiarpur, Punjab.*

NOTICE

Manual of Indian Timbers

BY J. S. GAMBLE.

Copies of this book, which is a reprint of the second edition with some corrections and additions, printed in 1922 by Messrs. Sampson Low, Marston and Company, Ltd., London, are available for sale at the Forest Research Institute at the reduced price of Rs. 5 per copy only excluding postage charges.

The price has been purposely reduced in order to clear out the stock of this useful and handy book.

Forest Officers and others who wish to buy the book should send their requirements to the President, Forest Research Institute and College, New Forest P. O., Dehra Dun.

The following information is taken from the statement relating to the

IMPORTS

ARTICLES	QUANTITY (cubic tons)					
	MONTH OF SEPTEMBER			6 MONTHS, 1ST APRIL TO 30TH SEPTEMBER.		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	136	18	..	520	654	30
French Indo-China	651	107	358	1,482	2,552	2,720
Burma ..	11,202	12,660	13,408	77,145	75,131	74,410
Java ..	501	540	157	2,811	1,790	1,699
Other countries ..	..	..	..	517	10	..
Total ..	12,490	13,325	13,923	82,475	80,137	78,859
Other than Teak—						
Softwoods ..	449	1,071	664	9,037	7,940	6,452
Matchwoods ..	650	417	164	5,483	4,852	4,647
Unspecified (value)						
Firewood ..	32	142	4	321	428	244
Sandalwood ..	34	..	39	89	46	96
Total ..	1,165	1,630	871	14,930	13,266	11,439
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	..	..	..	..	..	..
Sleepers of wood ..	78	16	266	329	149	864
Plywood (tons) ..	118	161	457	2,871	2,447	3,760
Other manufactures of wood (value) ..	..	..	..	..	..	..
Total ..	196	177	723	3,200	2,596	4,624
Total Volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	15,129	15,957	20,399	110,477	155,577	92,269

Seaborne Trade and Navigation of British India for September 1939 :

IMPORTS.

ARTICLES	VALUE (Rupees)					
	MONTH OF SEPTEMBER			6 MONTHS, 1ST APRIL TO 30TH SEPTEMBER		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
Siam ..	15,983	2,540	..	61,481	84,094	3,336
French Indo-China	80,688	13,006	39,425	1,70,224	3,11,017	2,93,092
Burma ..	16,44,959	17,38,762	16,49,455	98,20,911	1,01,05,497	93,08,220
Java ..	64,515	34,920	15,966	3,52,054	1,71,950	1,75,595
Other countries ..	..	..	..	56,196	806	..
Total ..	18,06,145	17,89,228	17,04,846	1,04,60,866	1,06,73,364	97,80,243
Other than Teak—						
Softwoods ..	33,540	62,529	53,009	6,75,495	5,79,543	4,33,984
Matchwoods ..	41,004	26,391	9,655	3,31,351	3,26,670	3,26,992
Unspecified (value)						
Firewood ..	480	1,225	60	4,812	5,501	3,670
Sandalwood ..	5,045	150	13,760	23,428	13,479	27,498
Total ..	80,069	90,295	76,484	12,35,086	9,25,193	7,92,144
Manufactures of Wood and Timber—						
Furniture and Cabinetware ..	1,67,247	1,65,403	94,216	11,63,194	8,81,396	7,73,328
Sleepers of wood ..	15,593	2,865	33,249	54,165	22,141	1,17,584
Plywood (tons) ..	17,658	52,561	97,893	6,07,458	5,54,700	7,11,991
Other manufactures of wood (value) ..	1,25,963	1,05,808	1,09,801	9,26,500	8,03,760	7,81,775
Total ..	3,26,461	3,26,637	3,35,159	27,51,317	22,61,967	23,84,678
Total value of Wood and Timber ..	22,71,775	22,33,972	22,57,803	1,42,20,264	1,45,38,563	1,35,47,713
Other Products of Wood and Timber—						
Wood pulp (cwt.) ..	1,22,471	1,65,048	1,04,350	8,54,269	15,05,469	6,53,836

EXPORTS

ARTICLES	QUANTITY (CUBIC TONS)					
	MONTH OF SEPTEMBER			6 MONTHS, 1ST APRIL TO 30TH SEPTEMBER		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	39	..	..	139	2	20
„ Germany ..	..	..	..	..	1	..
„ Iraq ..	..	11	..	100	151	268
„ Ceylon ..	..	..	..	1	1	30
„ Union of South Africa ..	..	..	..	..	..	..
„ Portuguese East Africa ..	..	..	..	..	..	..
„ United States of America ..	..	..	..	..	..	..
„ Other countries	73	107	139	359	927	974
Total ..	112	118	139	599	1,082	1,292
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	7	..	..	10	..	..
Unspecified (value) Firewood ..	..	..	..	115	..	..
Total ..	7	..	..	125	..	..
Sandalwood—						
To United Kingdom	7	..	..	13	11	..
„ Japan ..	10	1	..	23	23	51
„ United States of America ..	100	52	176	318	187	222
„ Other countries	3	15	17	197	68	129
Total ..	120	68	193	551	289	402
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	..	..	..	..	..	..
Total volume of Wood and Timber ..	..	..	..	..	..	..
Other Products of Wood and Timber	..	..	..	..	..	..

EXPORTS

ARTICLES	VALUE (RUPEES)					
	MONTH OF SEPTEMBER.			6 MONTHS, 1ST APRIL TO 30TH SEPTEMBER		
	1937	1938	1939	1937	1938	1939
WOOD AND TIMBER						
Teakwood—						
To United Kingdom	5,337	..	..	19,775	375	2,600
„ Germany ..	..	..	..	..	150	..
„ Iraq ..	60	2,620	..	22,599	44,843	16,431
„ Ceylon ..	46	..	..	146	154	2,145
„ Union of South Africa ..	..	..	..	..	..	..
„ Portuguese East Africa ..	..	..	..	..	..	..
„ United States of America ..	..	..	..	..	..	..
„ Other countries	19,738	41,575	35,535	97,987	3,18,678	1,96,594
Total ..	25,181	44,195	35,535	1,40,507	3,64,200	2,17,770
Teak keys (tons) ..	..	..	..	..	..	..
Hardwoods other than teak ..	1,700	..	..	2,540	72	..
Unspecified (value) Firewood ..	..	..	..	1,027	..	..
Total ..	1.700	..	..	3,567	72	..
Sandalwood—						
To United Kingdom	6,880	5	..	13,480	12,380	..
„ Japan ..	10,010	1,380	..	23,410	25,153	54,025
„ United States of America ..	1,00,000	52,400	1,88,700	3,16,840	1,94,400	2,37,810
„ Other countries	3,929	14,930	11,191	2,00,467	70,169	1,16,983
Total ..	1,20,819	68,715	1,99,891	5,54,197	3,02,102	4,08,818
Manufactures of Wood and Timber other than Furniture and Cabinetware (value)	23,372	51,086	49,167	1,28,358	2,23,229	1,74,159
Total value of Wood and Timber ..	2,25,736	1,72,231	3,06,016	16,54,285	10,09,633	9,47,937
Other Products of Wood and Timber ..	..	..	..	..	..	..